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(54) **METHOD AND DEVICE FOR MANAGING INTERACTIONS DIRECTED TO A USER INTERFACE WITH A PHYSICAL OBJECT**

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G06T 19/00	(2006.01)
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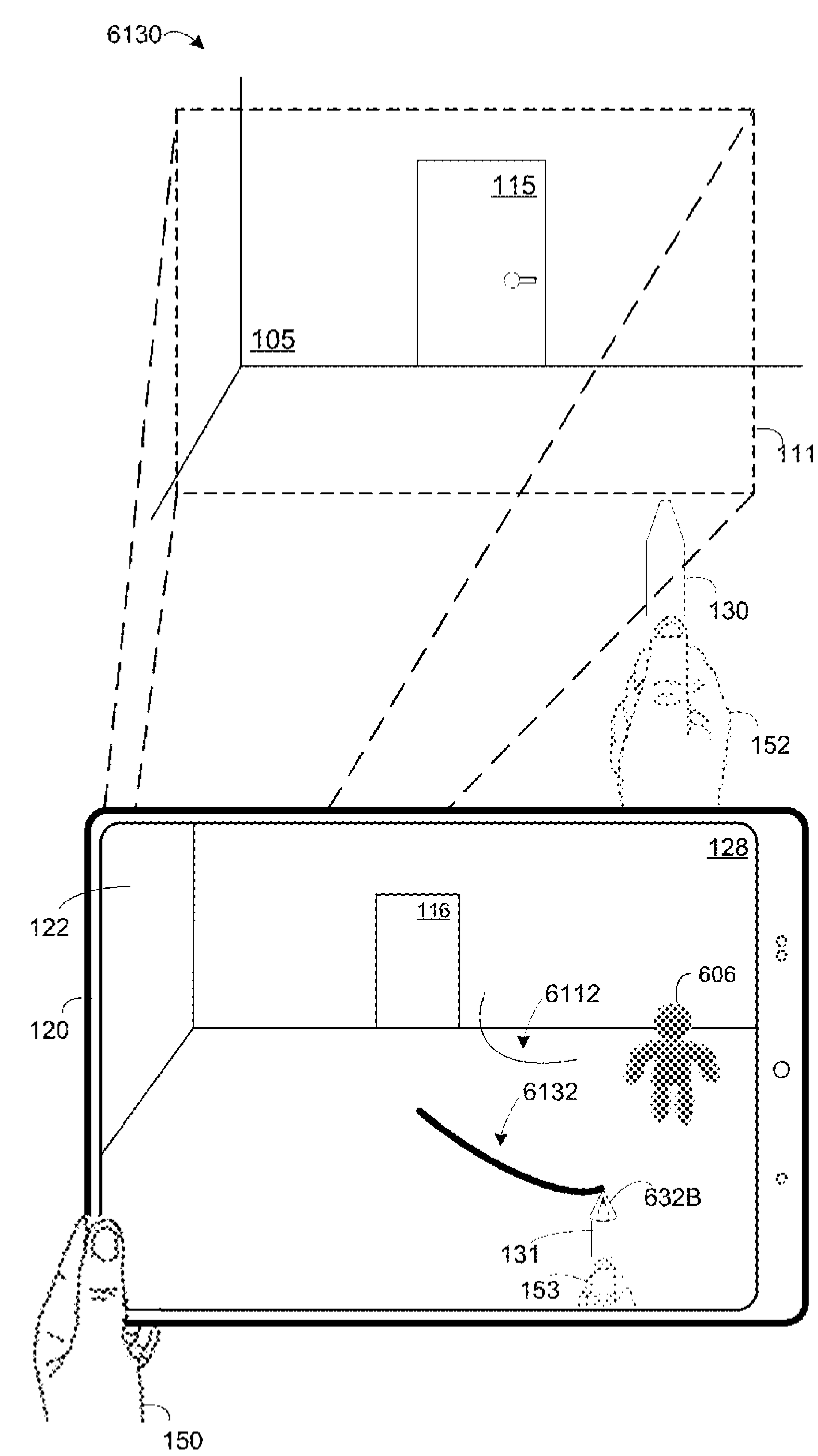
G06F 3/01	(2006.01)
G06F 3/0346	(2006.01)

(52) **U.S. Cl.**

CPC ***G06F 3/04815*** (2013.01); ***G06T 19/006*** (2013.01); ***G06F 3/04883*** (2013.01); ***G06F 3/017*** (2013.01); ***G06F 3/011*** (2013.01); ***G06F 3/0346*** (2013.01); *G06T 2200/24* (2013.01); *G06F 3/03545* (2013.01)

(57) **ABSTRACT**

The method includes: displaying first graphical elements associated with first plurality of output modalities within an XR environment; while displaying the first graphical elements, detecting movement of a physical object; and in response to detecting the movement of the physical object: in accordance with a determination that the movement of the physical object causes the physical object to breach a distance threshold relative to a first graphical element among the first graphical elements, selecting a first output modality associated with the first graphical element as a current output modality for the physical object; and in accordance with a determination that the movement of the physical object causes the physical to breach the distance threshold relative to a second graphical element among the first graphical elements, selecting a second output modality associated with the second graphical element as the current output modality for the physical object.



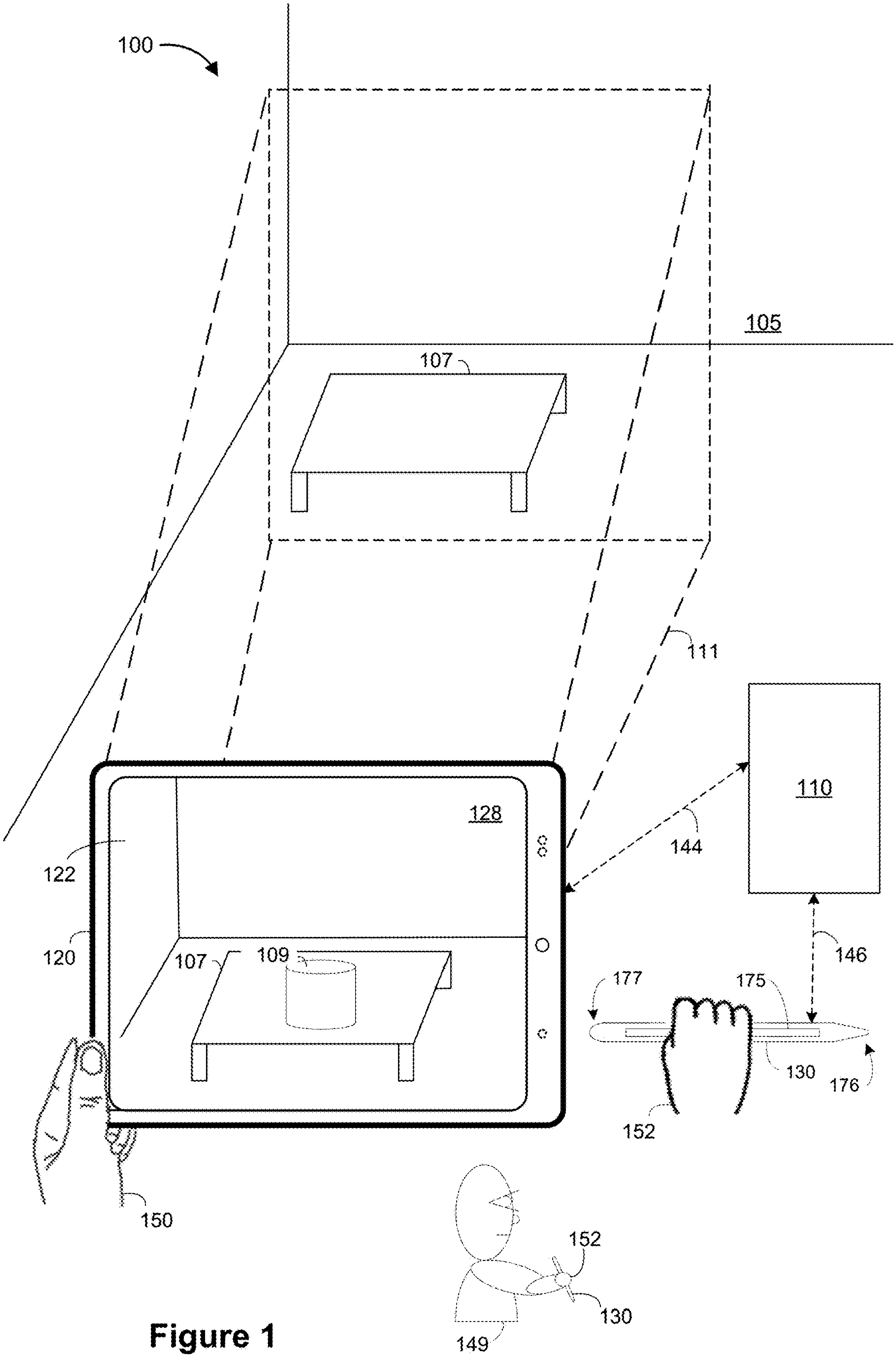

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Figure 1

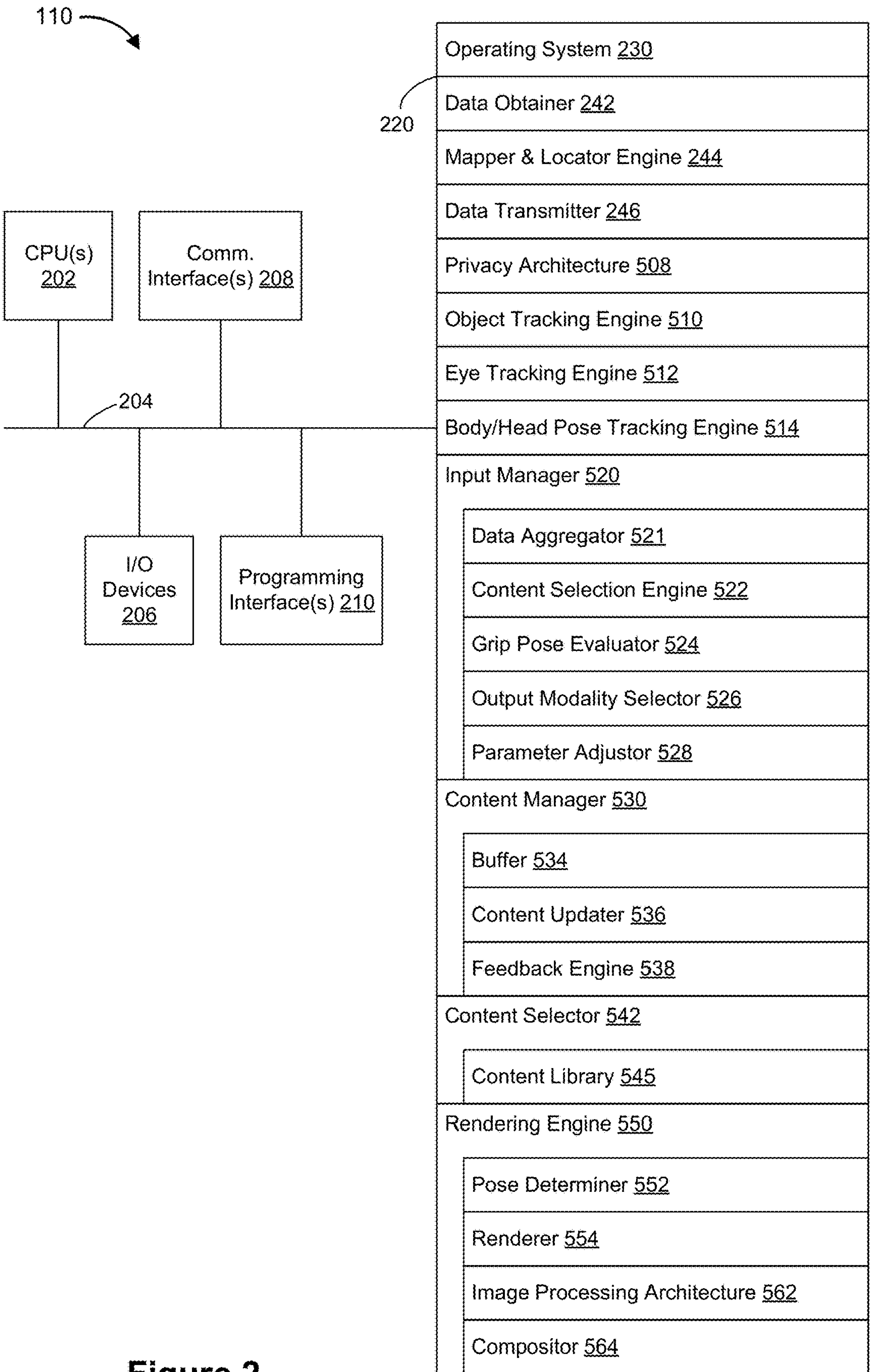

110
220
Operating System 230
Data Obtainer 242
Mapper & Locator Engine 244
Data Transmitter 246
Privacy Architecture 508
Object Tracking Engine 510
Eye Tracking Engine 512
Body/Head Pose Tracking Engine 514
Input Manager 520
Data Aggregator 521
Content Selection Engine 522
Grip Pose Evaluator 524
Output Modality Selector 526
Parameter Adjustor 528
Content Manager 530
Buffer 534
Content Updater 536
Feedback Engine 538
Content Selector 542
Content Library 545
Rendering Engine 550
Pose Determiner 552
Renderer 554
Image Processing Architecture 562
Compositor 564
CPU(s) 202
Comm. Interface(s) 208
204
I/O Devices 206
Programming Interface(s) 210

Figure 2

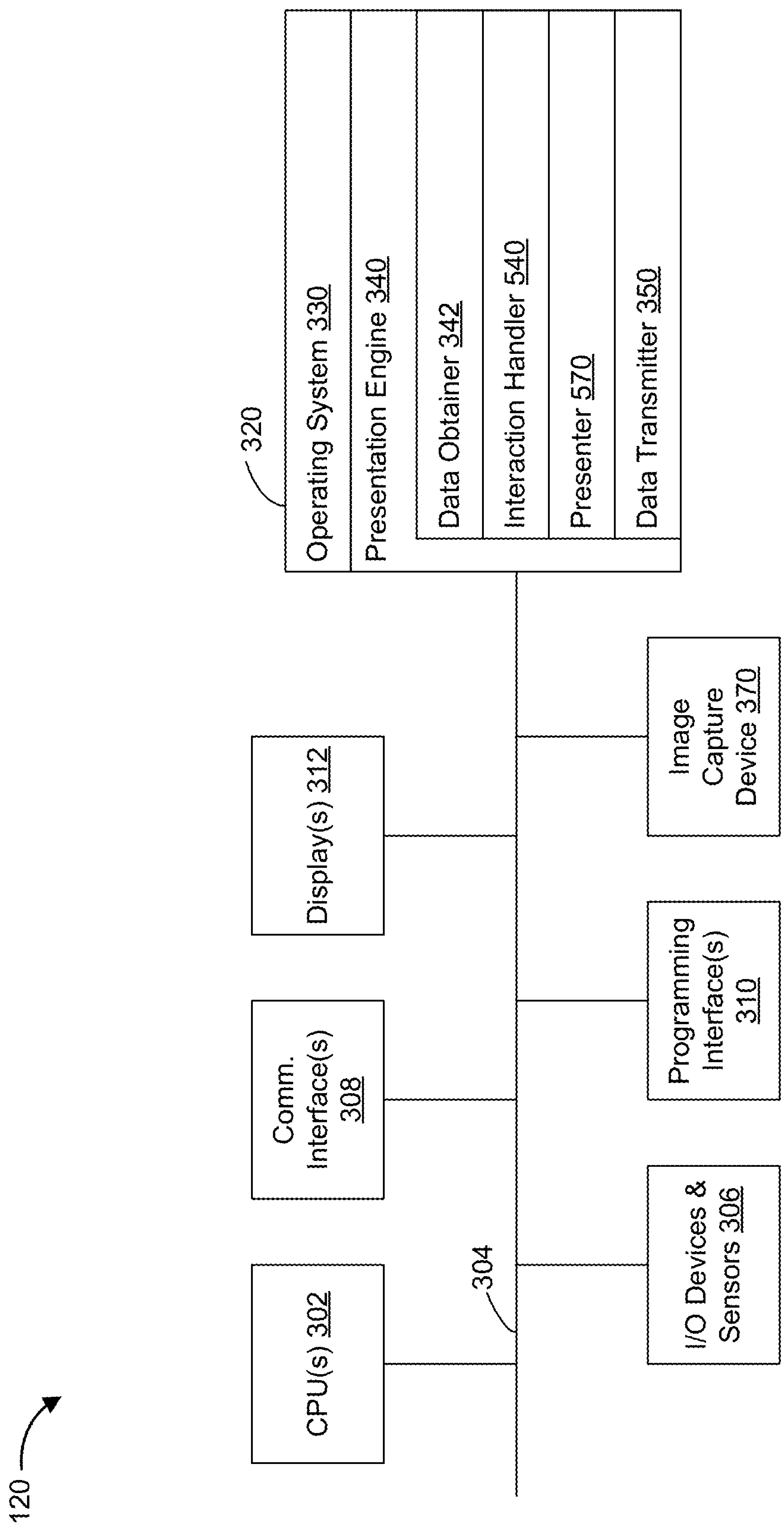

120
320
Operating System 330
Presentation Engine 340
Data Obtainer 342
Interaction Handler 540
Presenter 570
Data Transmitter 350
CPU(s) 302
304
Comm. Interface(s) 308
Display(s) 312
I/O Devices & Sensors 306
Programming Interface(s) 310
Image Capture Device 370

Figure 3

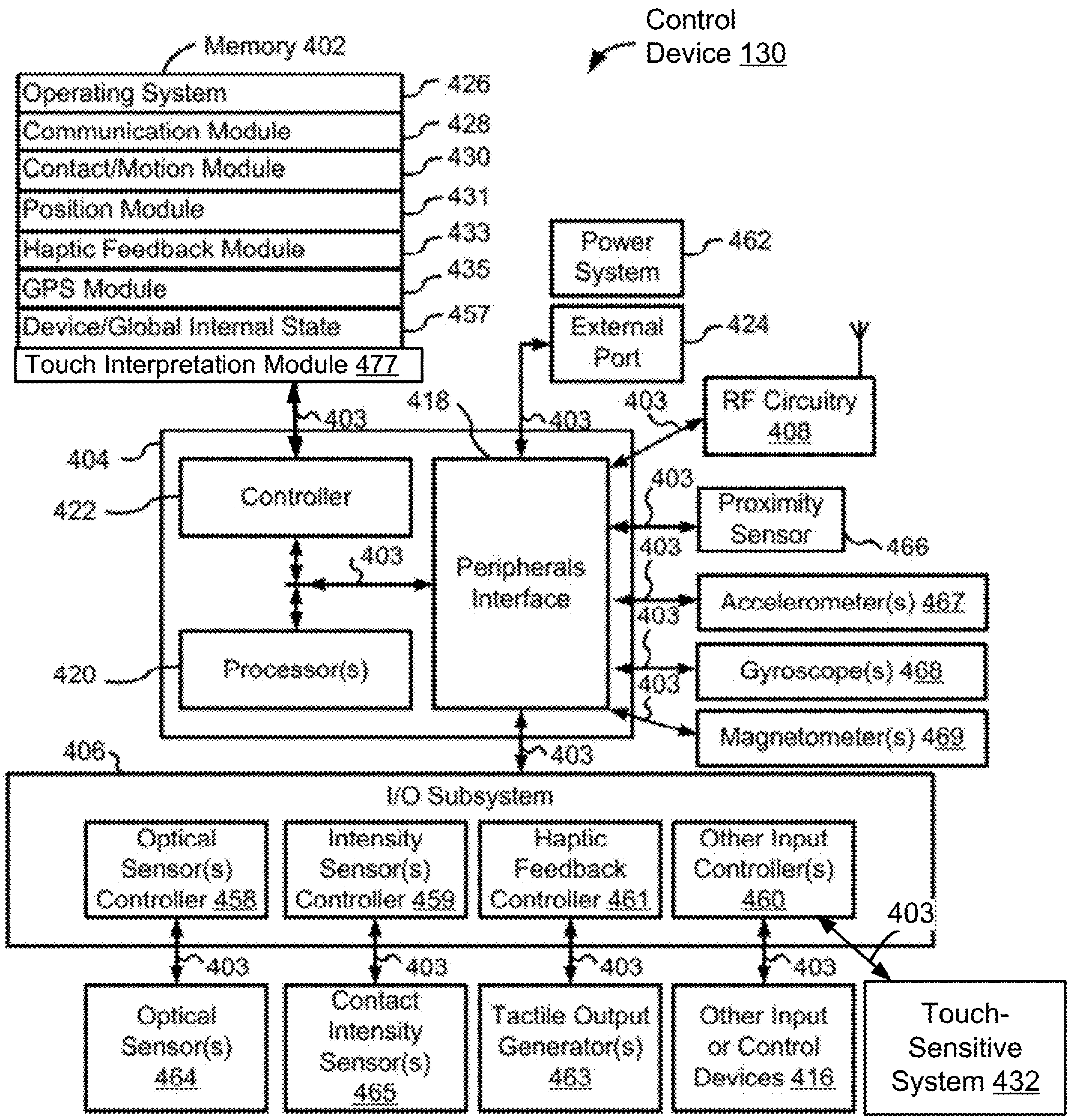

Control Device 130
Memory 402
Operating System
426
Communication Module
428
Contact/Motion Module
430
Position Module
431
Haptic Feedback Module
433
GPS Module
435
Device/Global Internal State
457
Touch Interpretation Module 477
Power System
462
External Port
424
RF Circuitry 408
403
418
404
422
Controller
Peripherals Interface
Processor(s)
420
Proximity Sensor
466
Accelerometer(s) 467
Gyroscope(s) 468
Magnetometer(s) 469
406
I/O Subsystem
Optical Sensor(s) Controller 458
Intensity Sensor(s) Controller 459
Haptic Feedback Controller 461
Other Input Controller(s) 460
Optical Sensor(s) 464
Contact Intensity Sensor(s) 465
Tactile Output Generator(s) 463
Other Input or Control Devices 416
Touch-Sensitive System 432

Figure 4

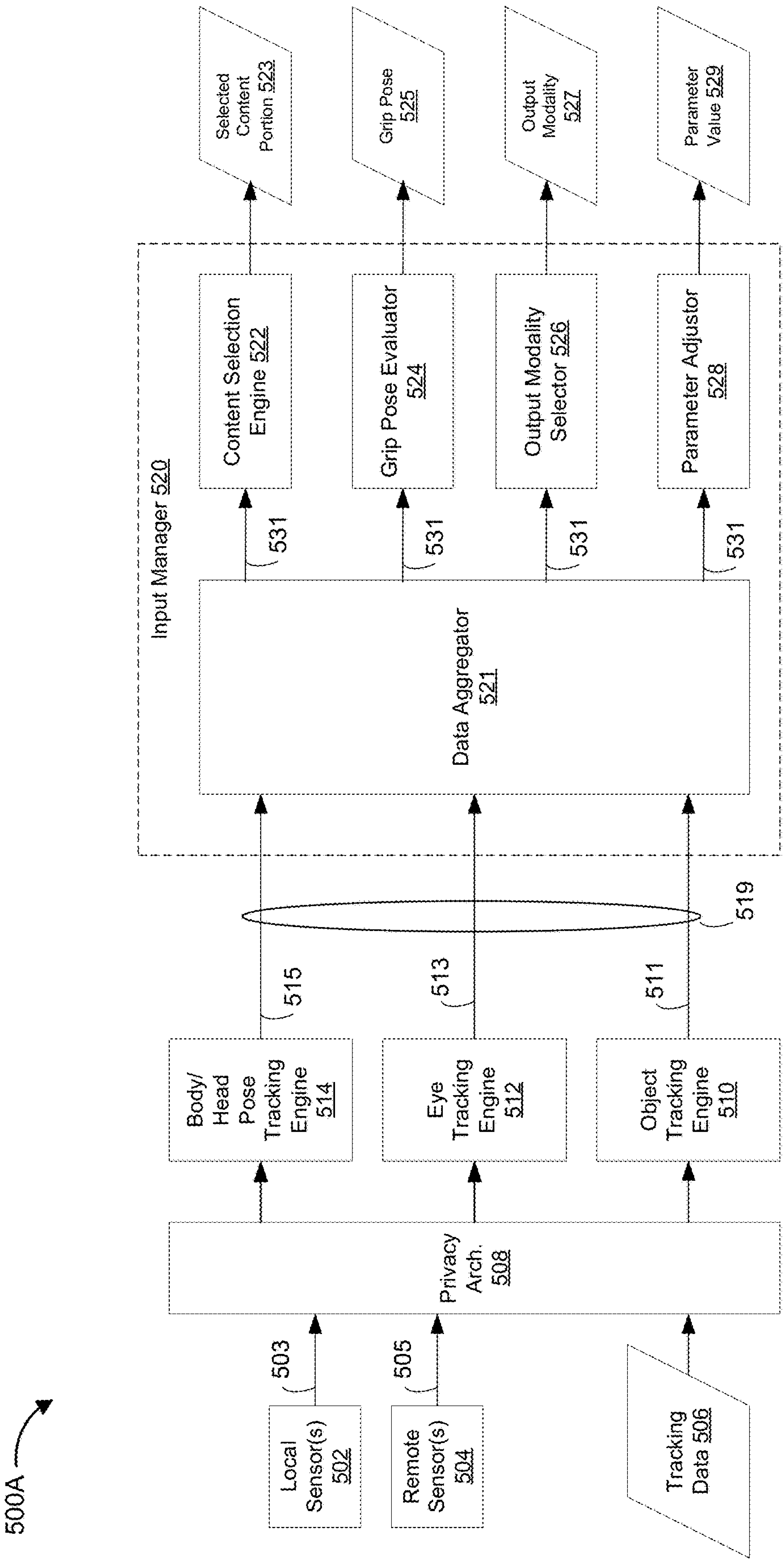
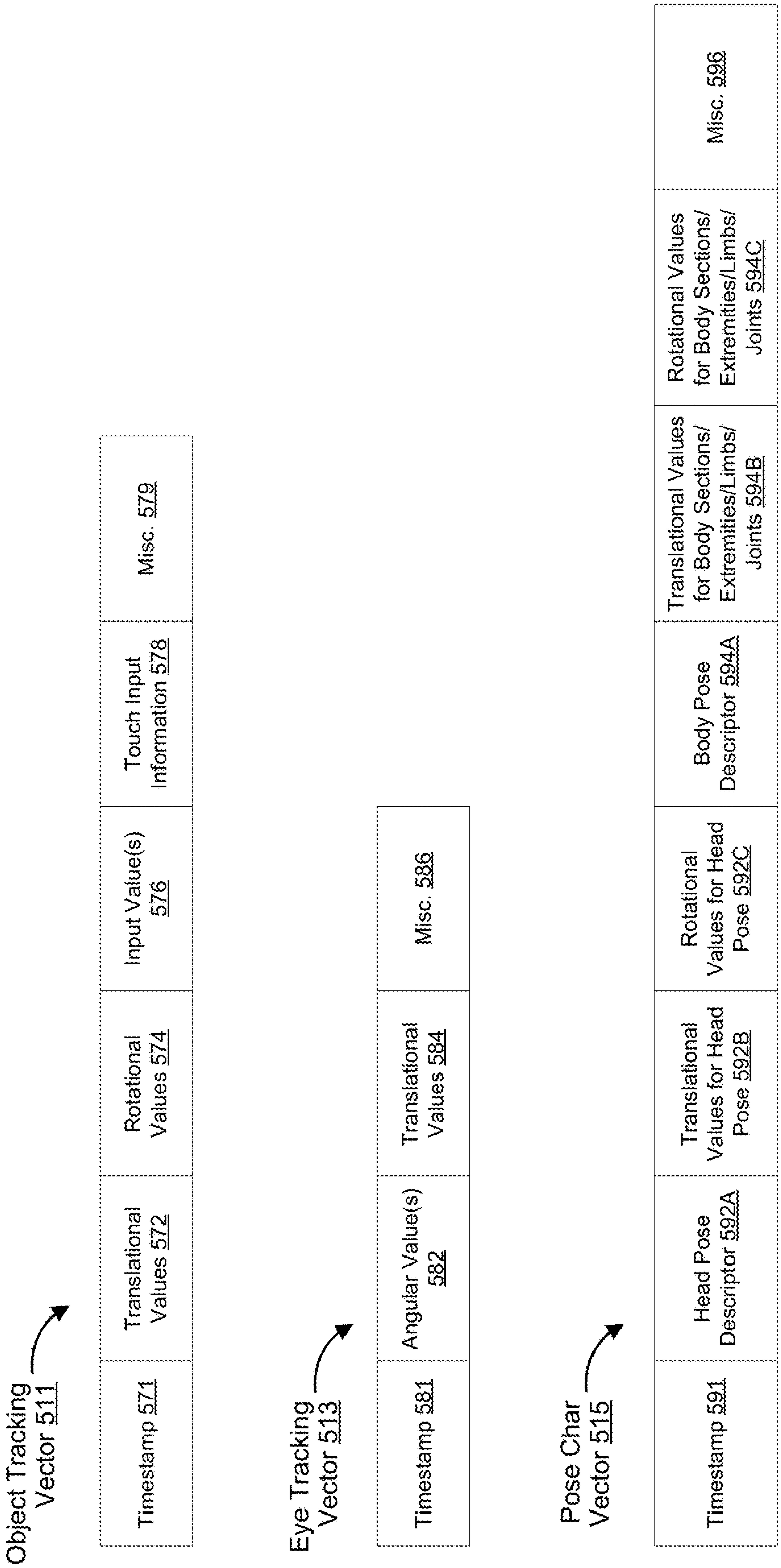
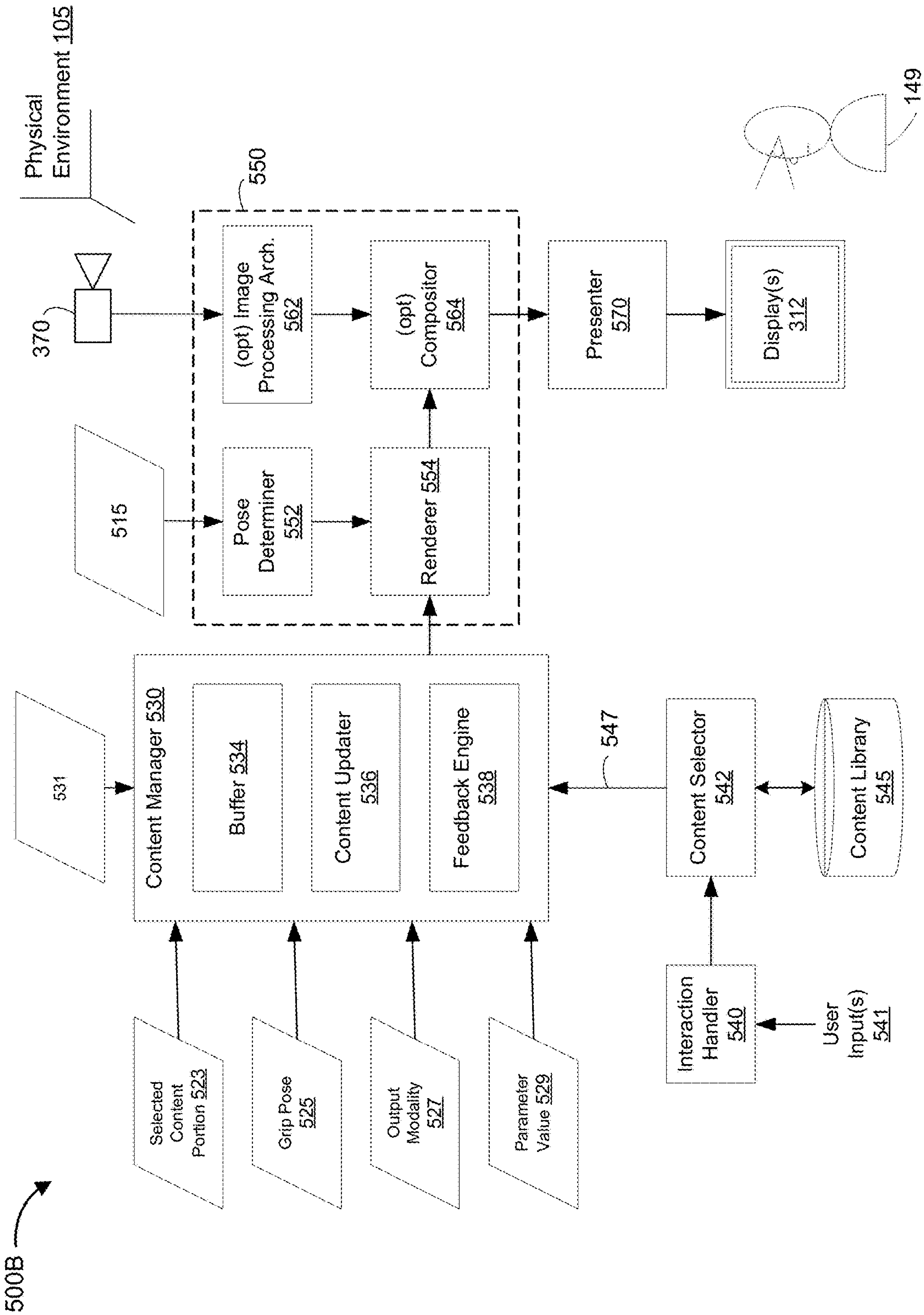

500A
Local Sensor(s) 502
503
Remote Sensor(s) 504
505
Tracking Data 506
Privacy Arch. 508
Body/ Head Pose Tracking Engine 514
Eye Tracking Engine 512
Object Tracking Engine 510
515
513
511
519
Input Manager 520
Data Aggregator 521
531
531
531
531
Content Selection Engine 522
Grip Pose Evaluator 524
Output Modality Selector 526
Parameter Adjustor 528
Selected Content Portion 523
Grip Pose 525
Output Modality 527
Parameter Value 529

Figure 5A



Object Tracking Vector 511
Timestamp 571
Translational Values 572
Rotational Values 574
Input Value(s) 576
Touch Input Information 578
Misc. 579
Eye Tracking Vector 513
Timestamp 581
Angular Value(s) 582
Translational Values 584
Misc. 586
Pose Char Vector 515
Timestamp 591
Head Pose Descriptor 592A
Translational Values for Head Pose 592B
Rotational Values for Head Pose 592C
Body Pose Descriptor 594A
Translational Values for Body Sections/ Extremities/Limbs/ Joints 594B
Rotational Values for Body Sections/ Extremities/Limbs/ Joints 594C
Misc. 596

Figure 5B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Grip Pose 525
Output Modality 527
Parameter Value 529
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Content Manager 530
Buffer 534
Content Updater 536
Feedback Engine 538
Interaction Handler 540
User Input(s) 541
Content Selector 542
547
Content Library 545
515
550
Pose Determiner 552
Renderer 554
(opt) Image Processing Arch. 562
(opt) Compositor 564
370
Physical Environment 105
Presenter 570
Display(s) 312
149

Figure 5C

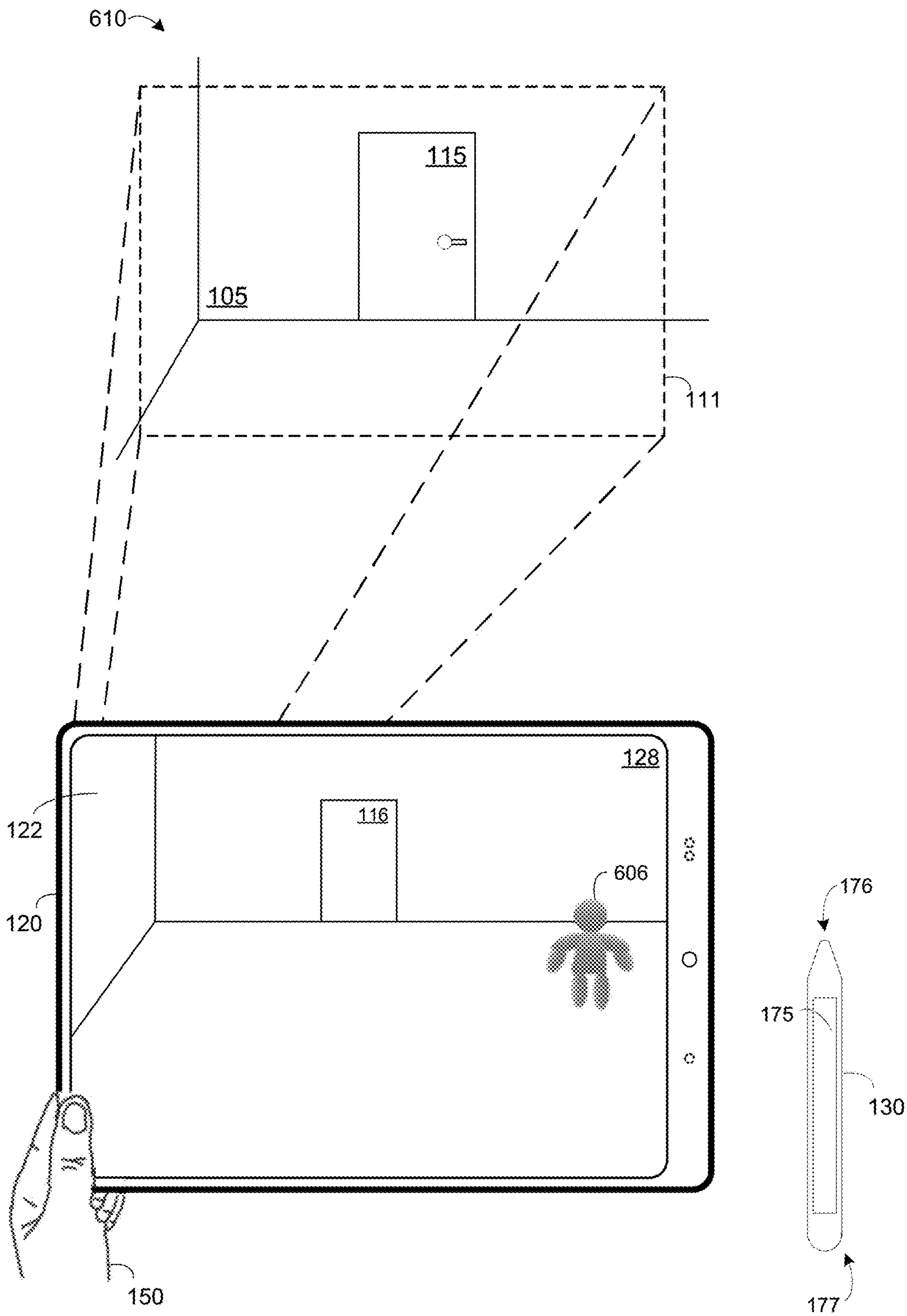


Figure 6A

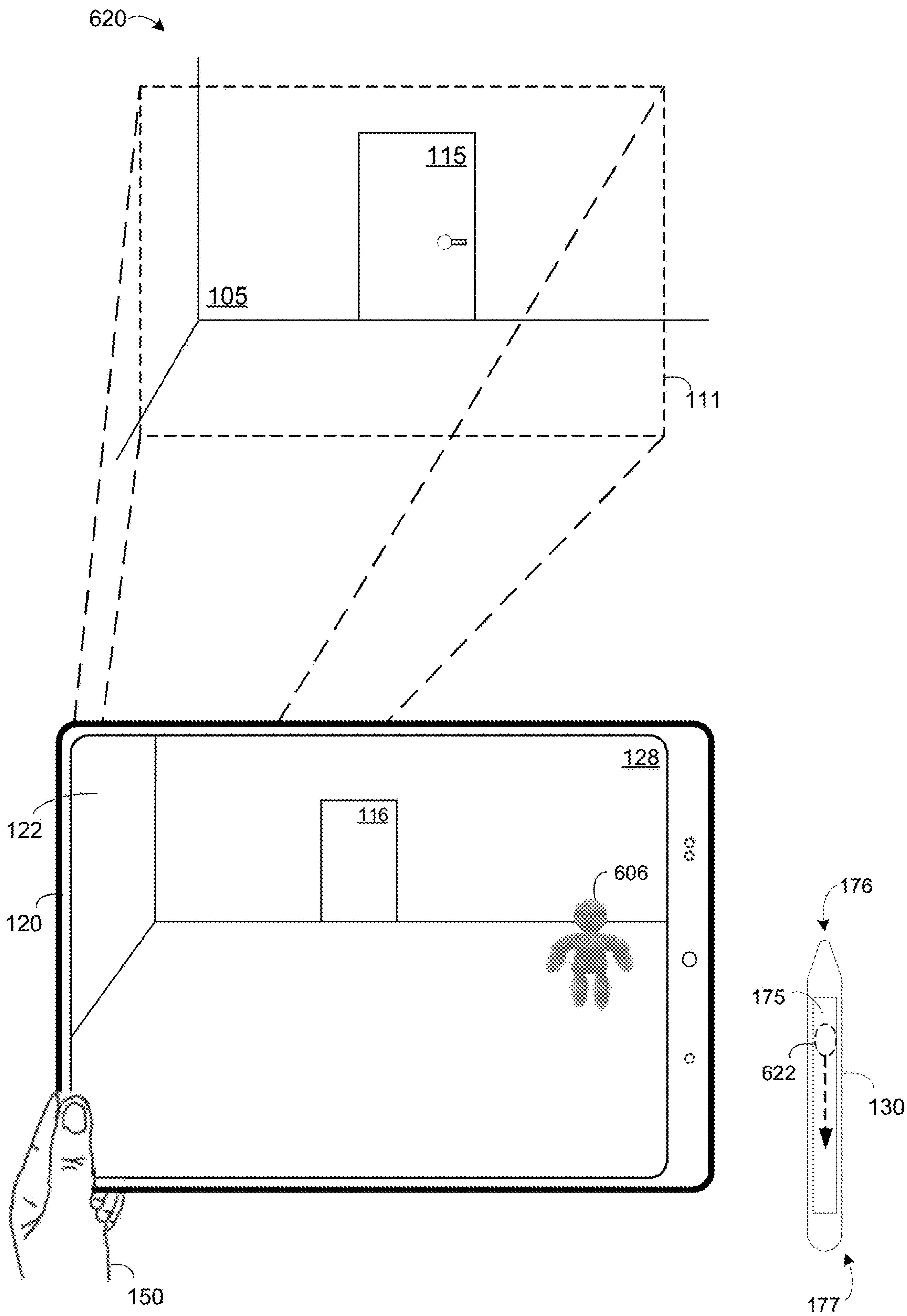
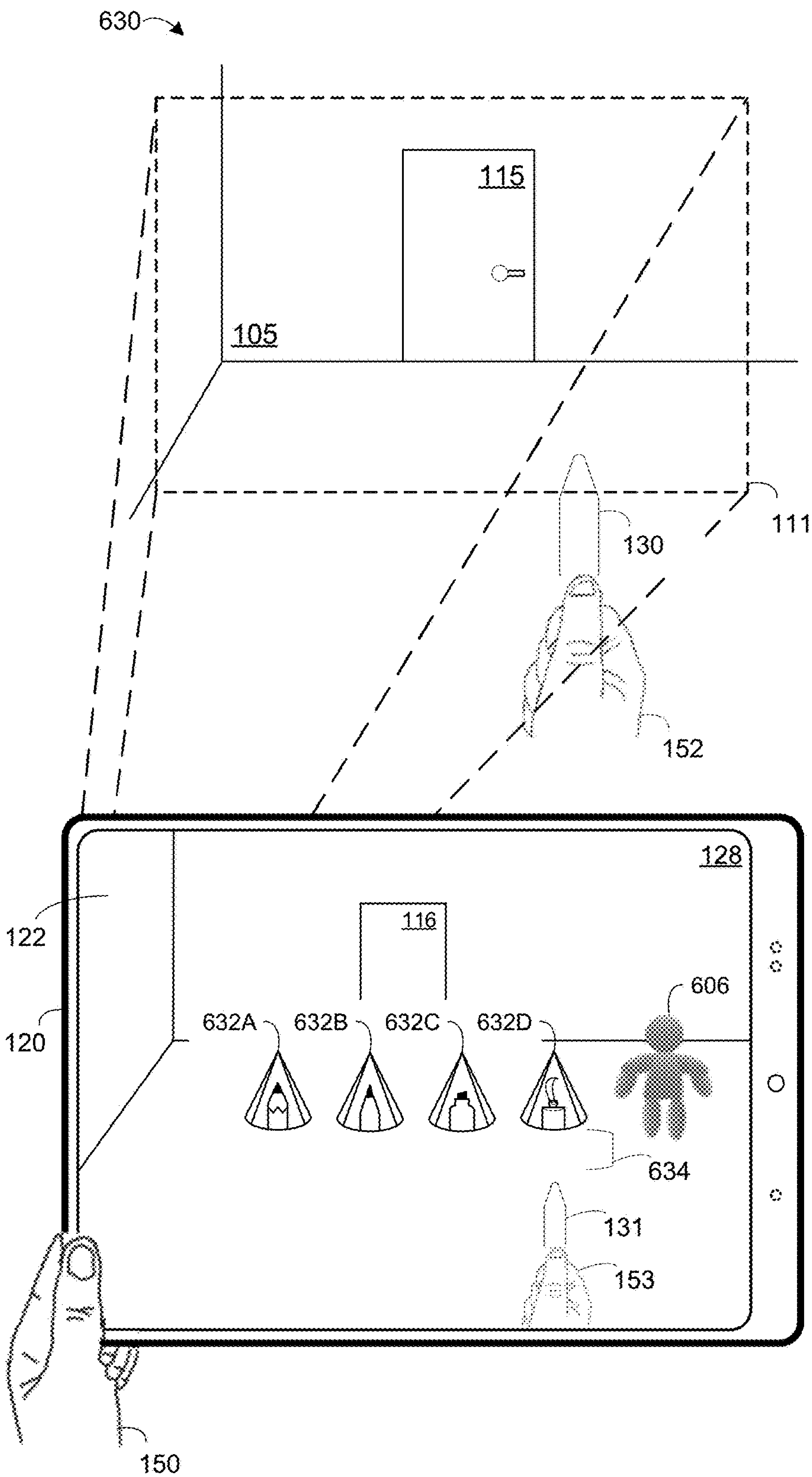


Figure 6B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632C
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Figure 6C

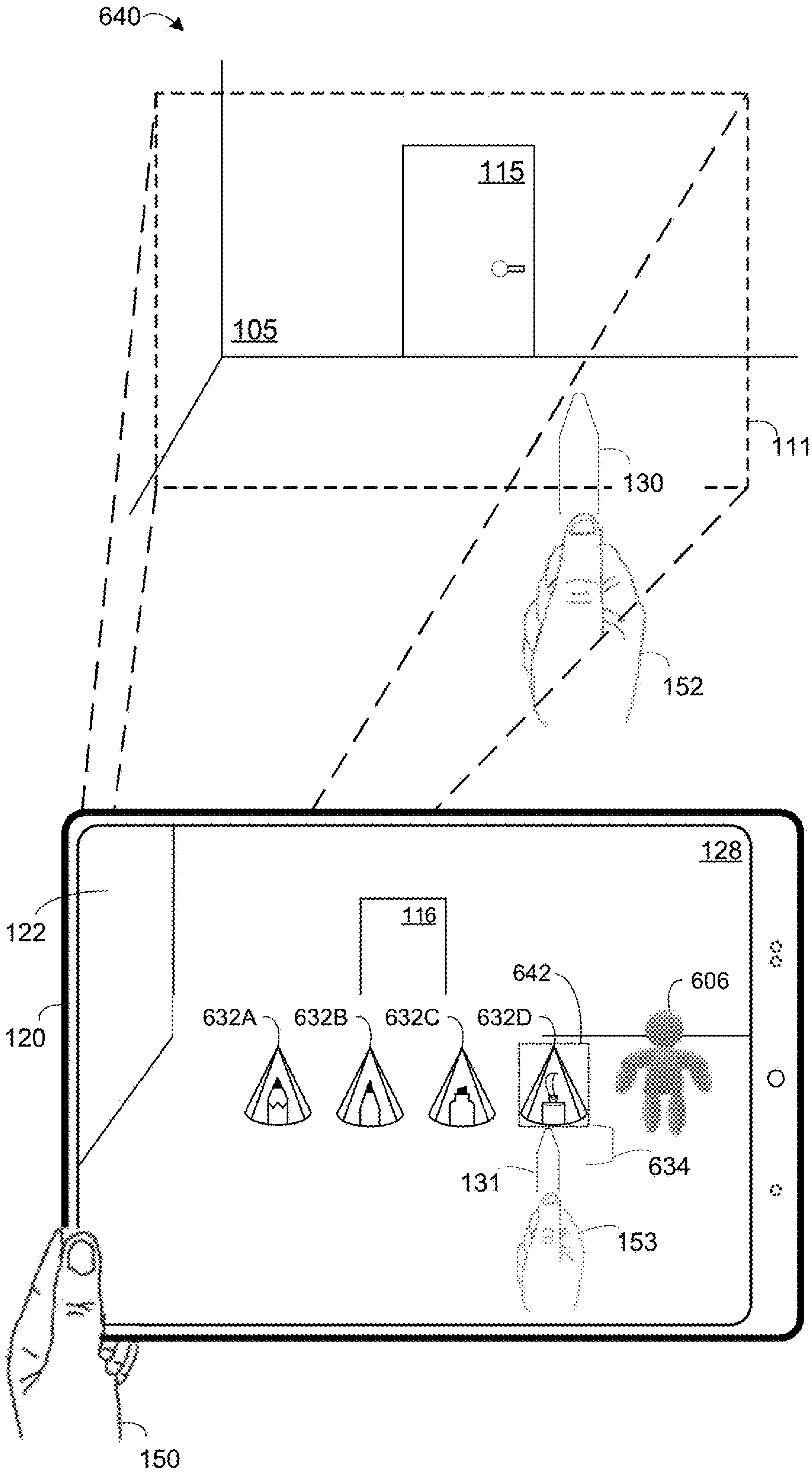
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Figure 6D

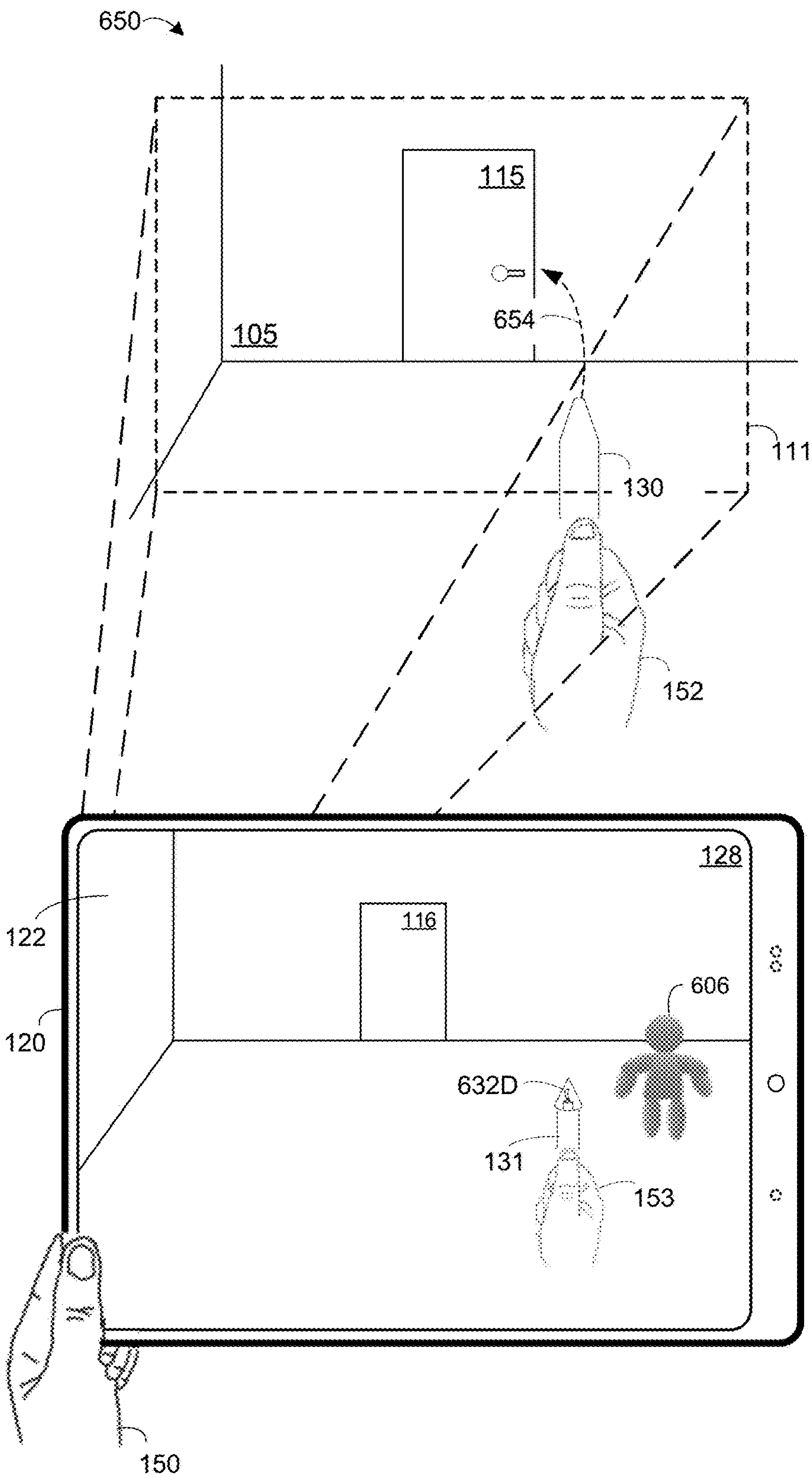

Figure 6E

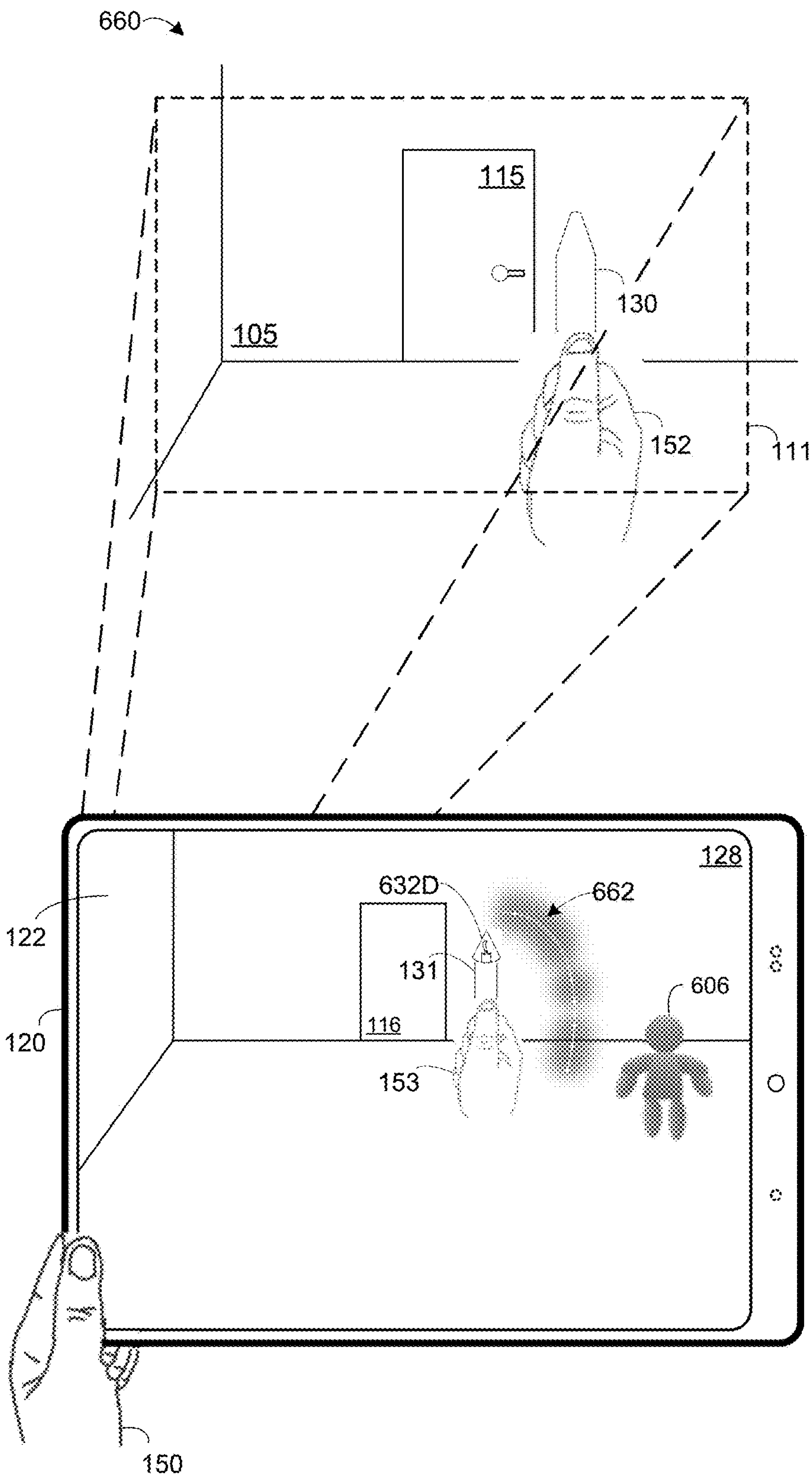

Figure 6F

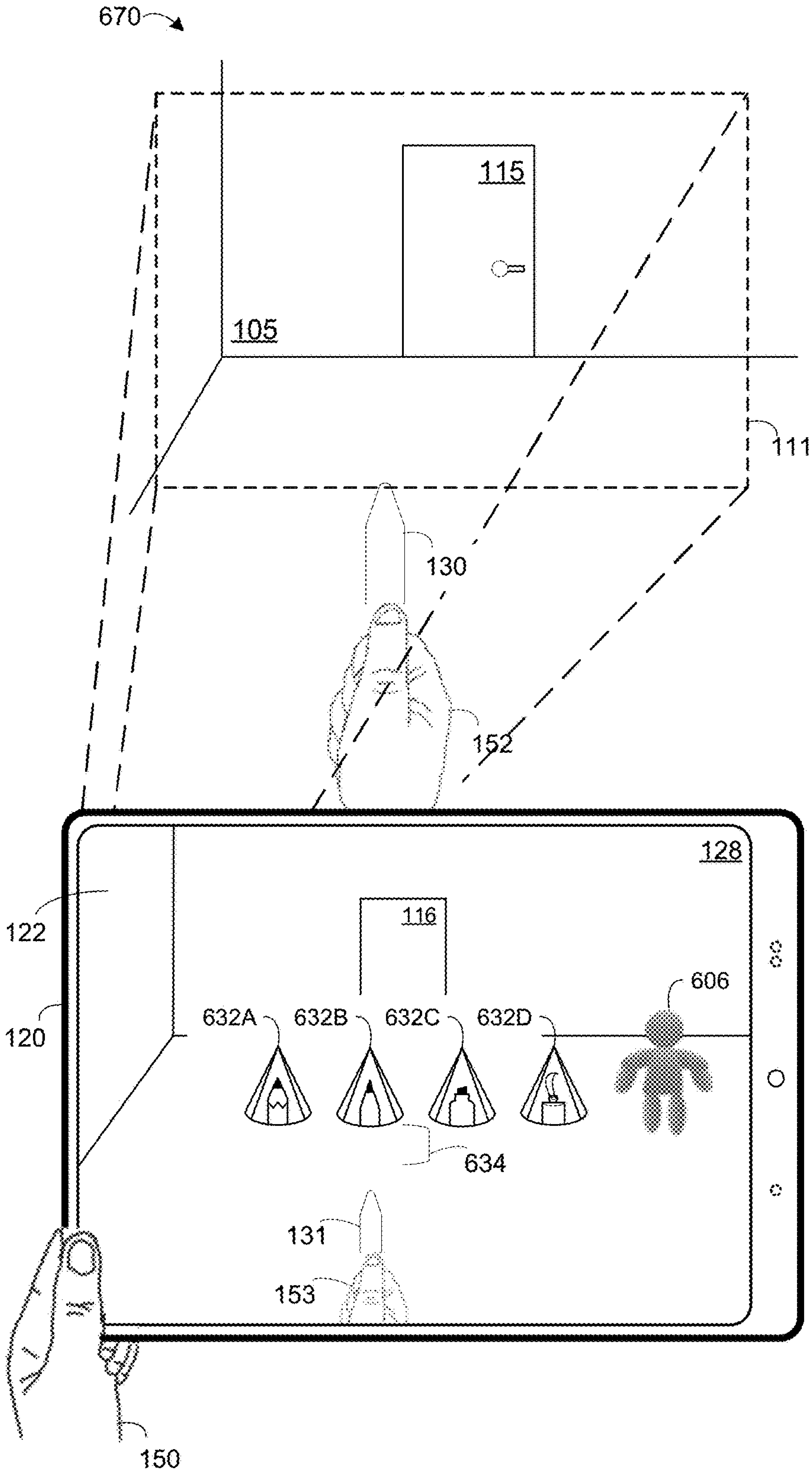
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Figure 6G

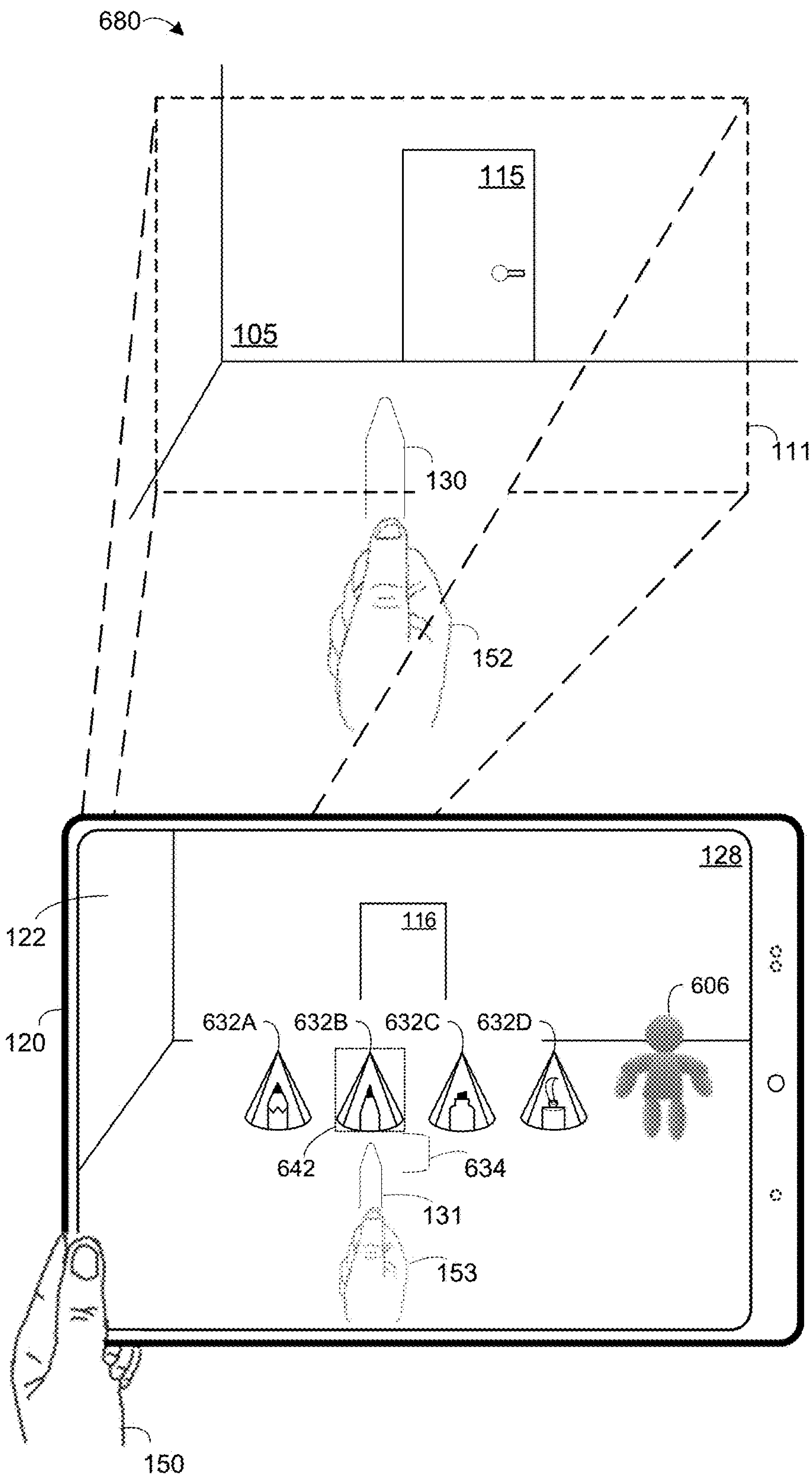
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Figure 6H

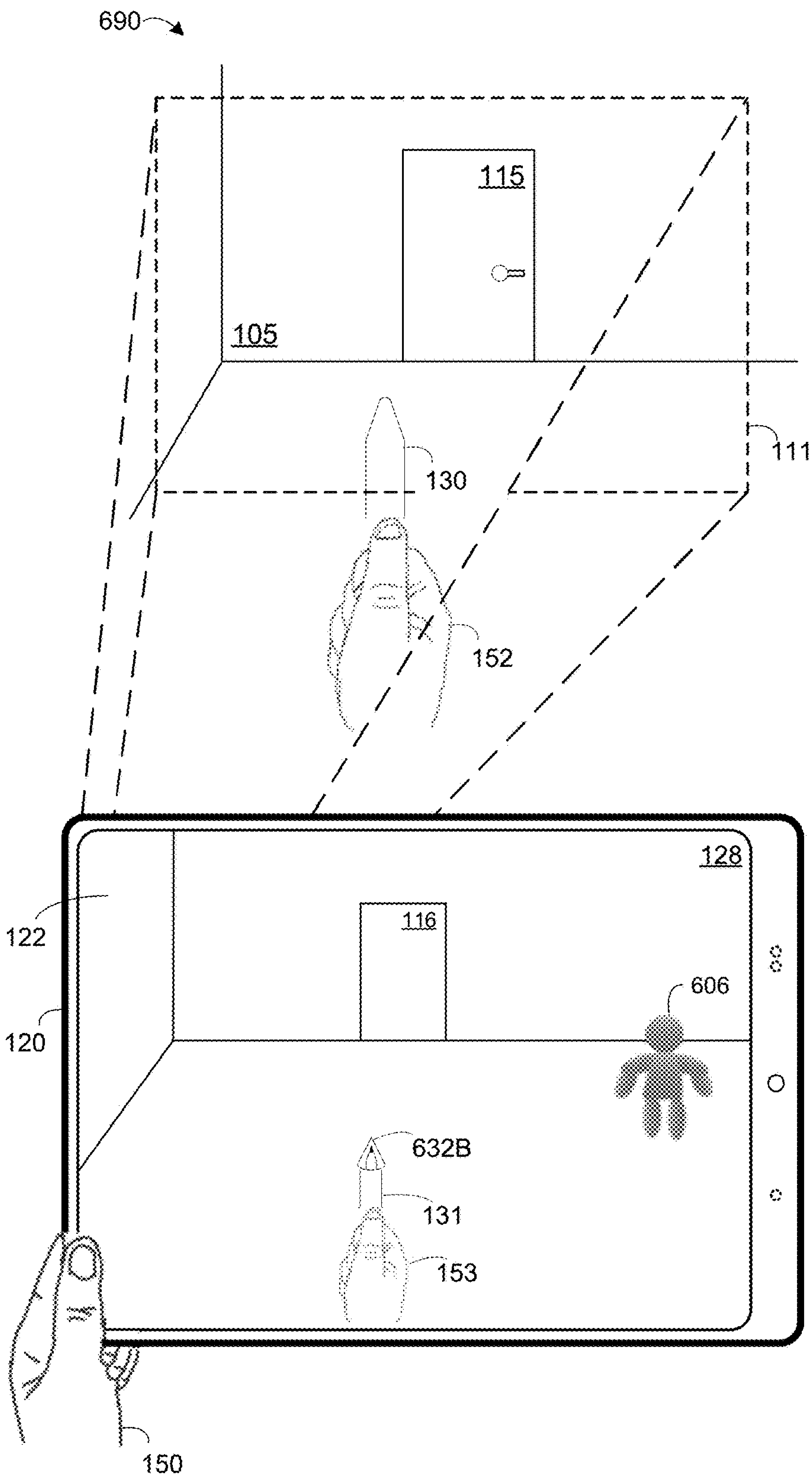
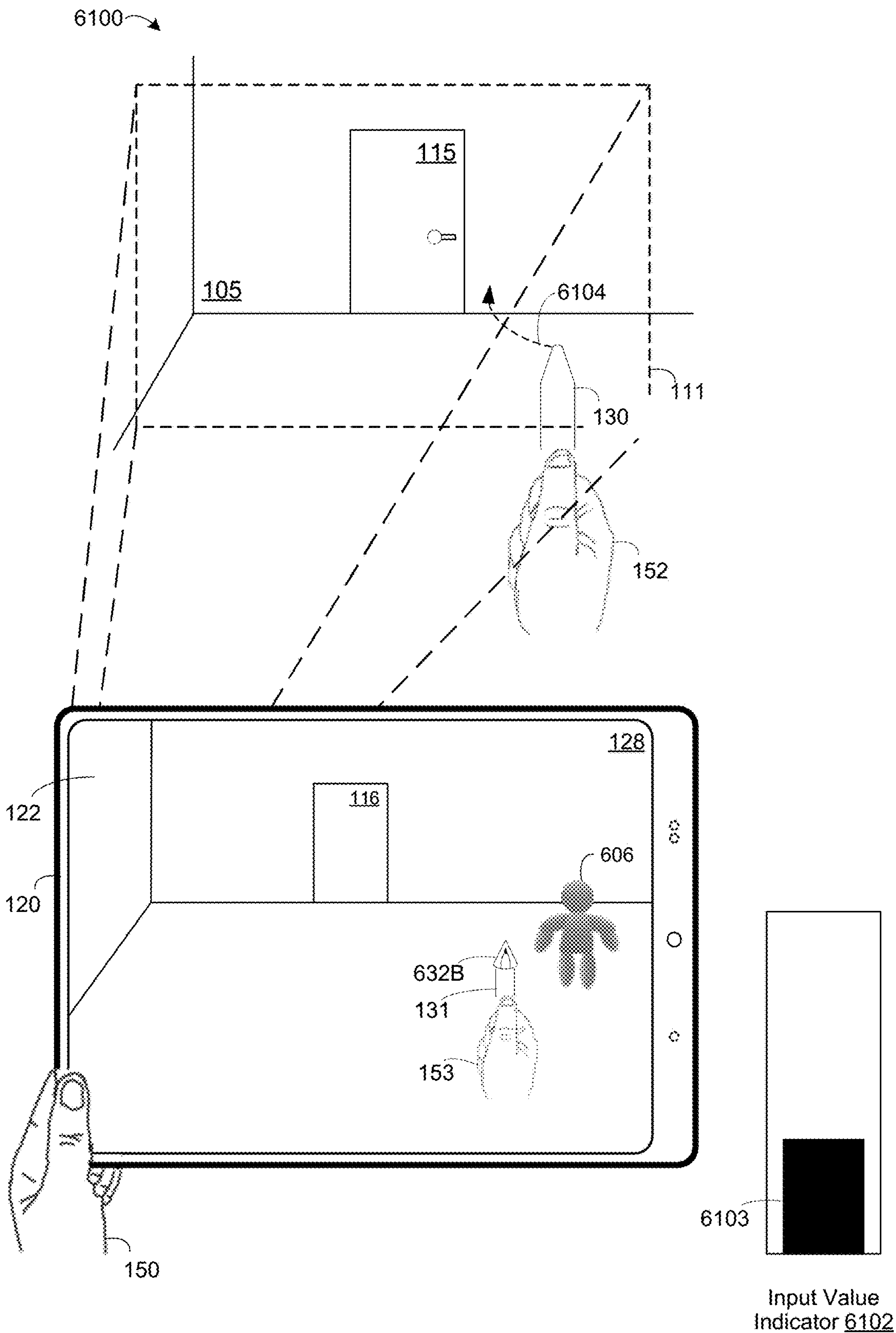


Figure 6I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632B
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150
6103
Input Value
Indicator 6102

Figure 6J

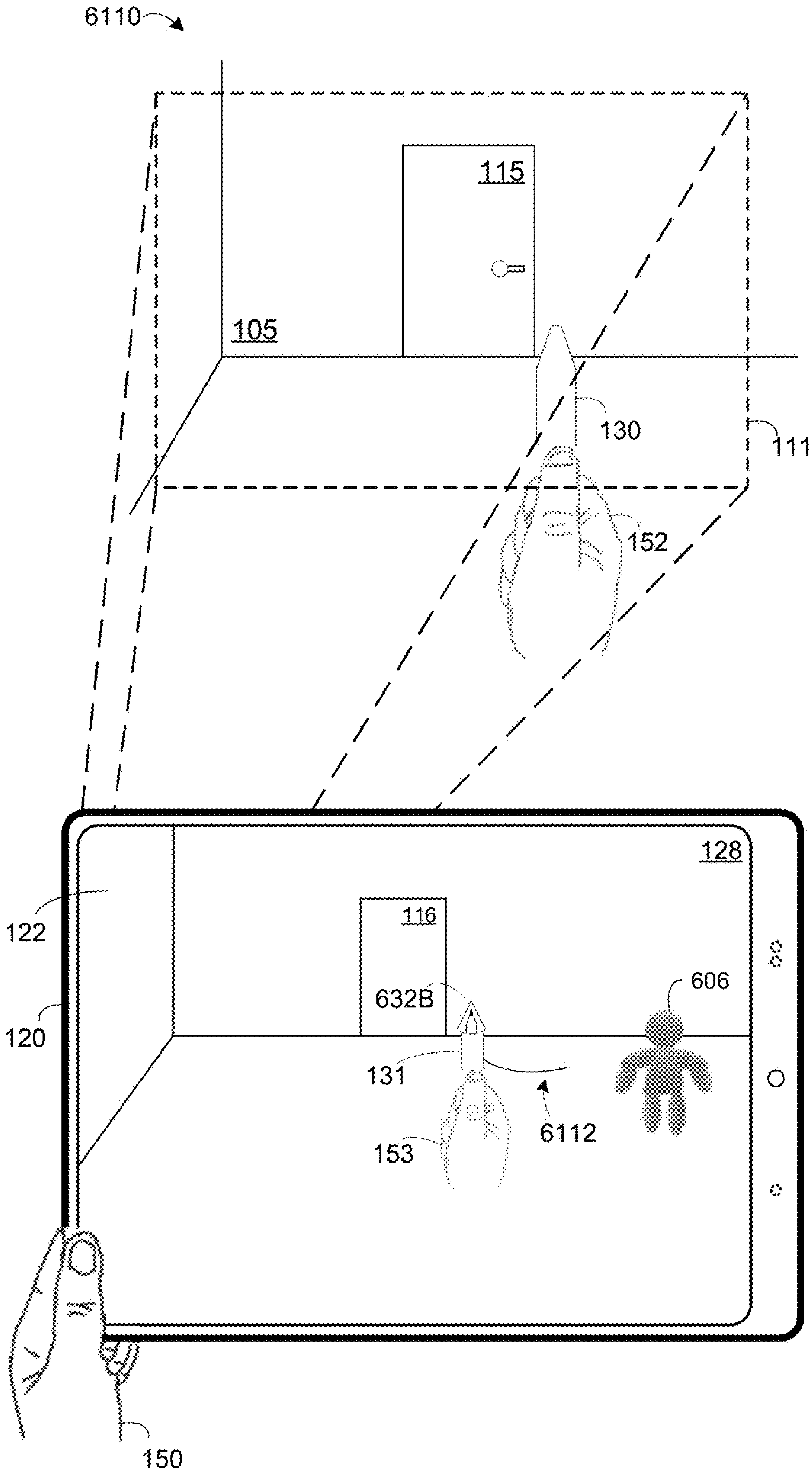
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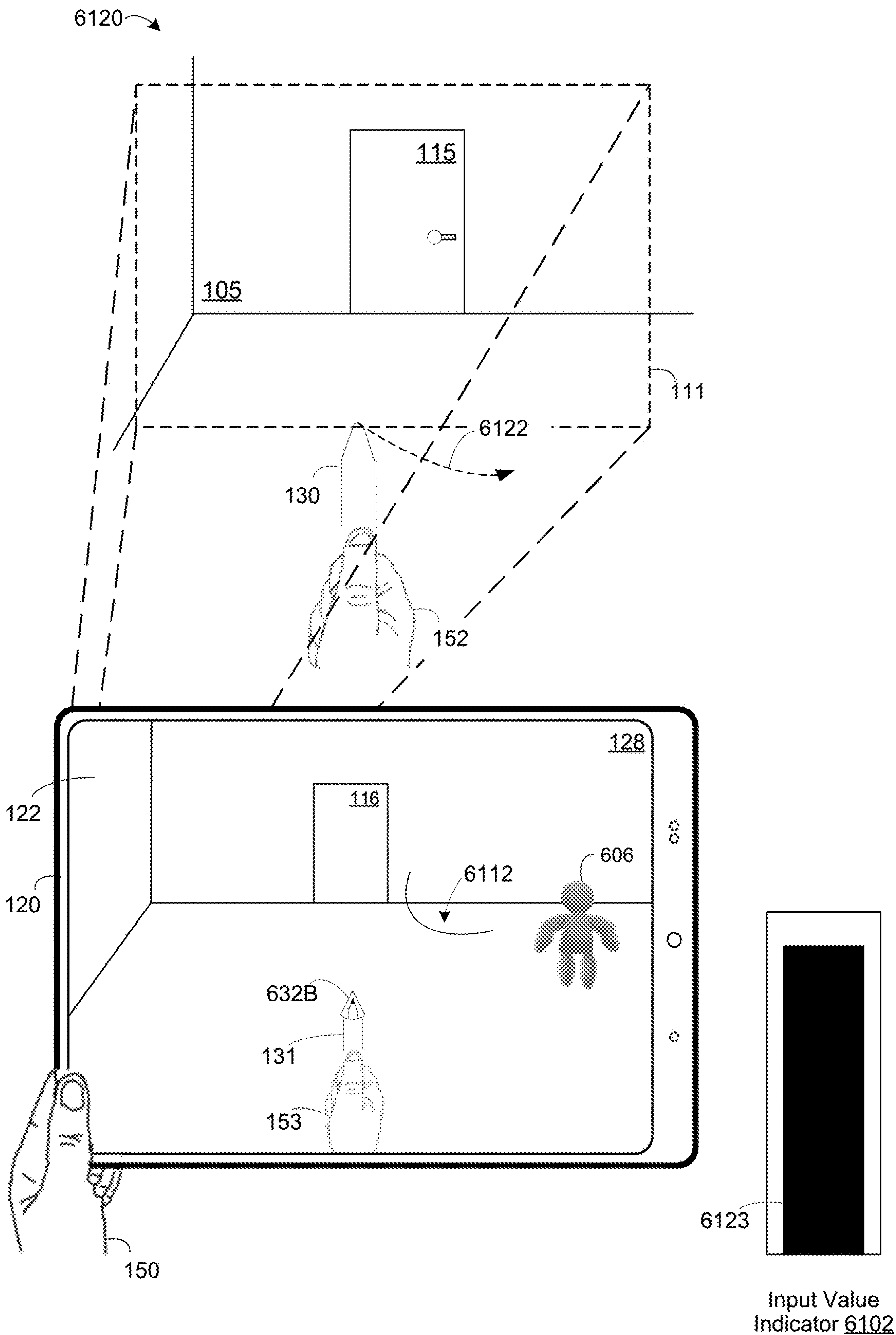
Figure 6K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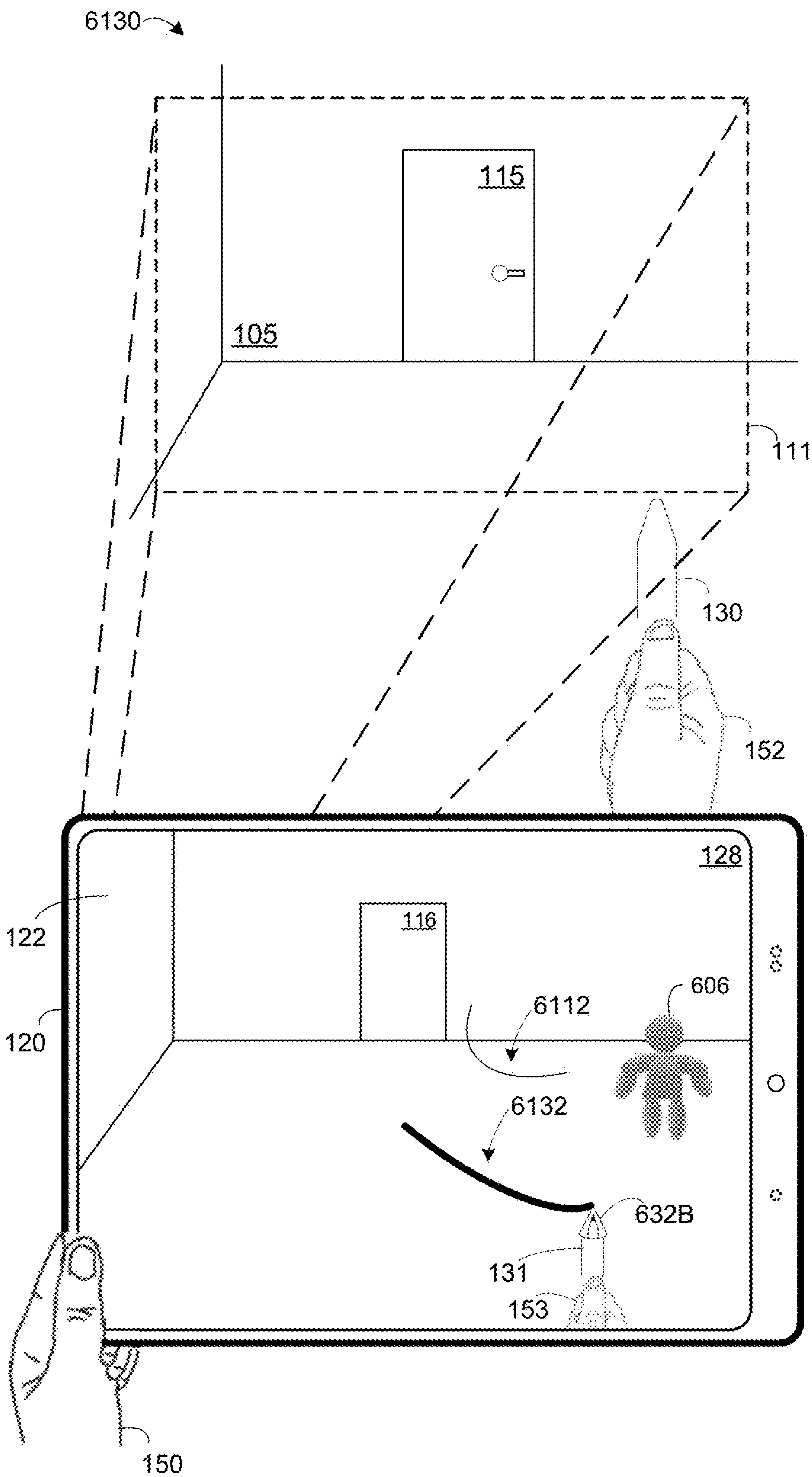
Input Value
Indicator 6102

Figure 6L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150

Figure 6M

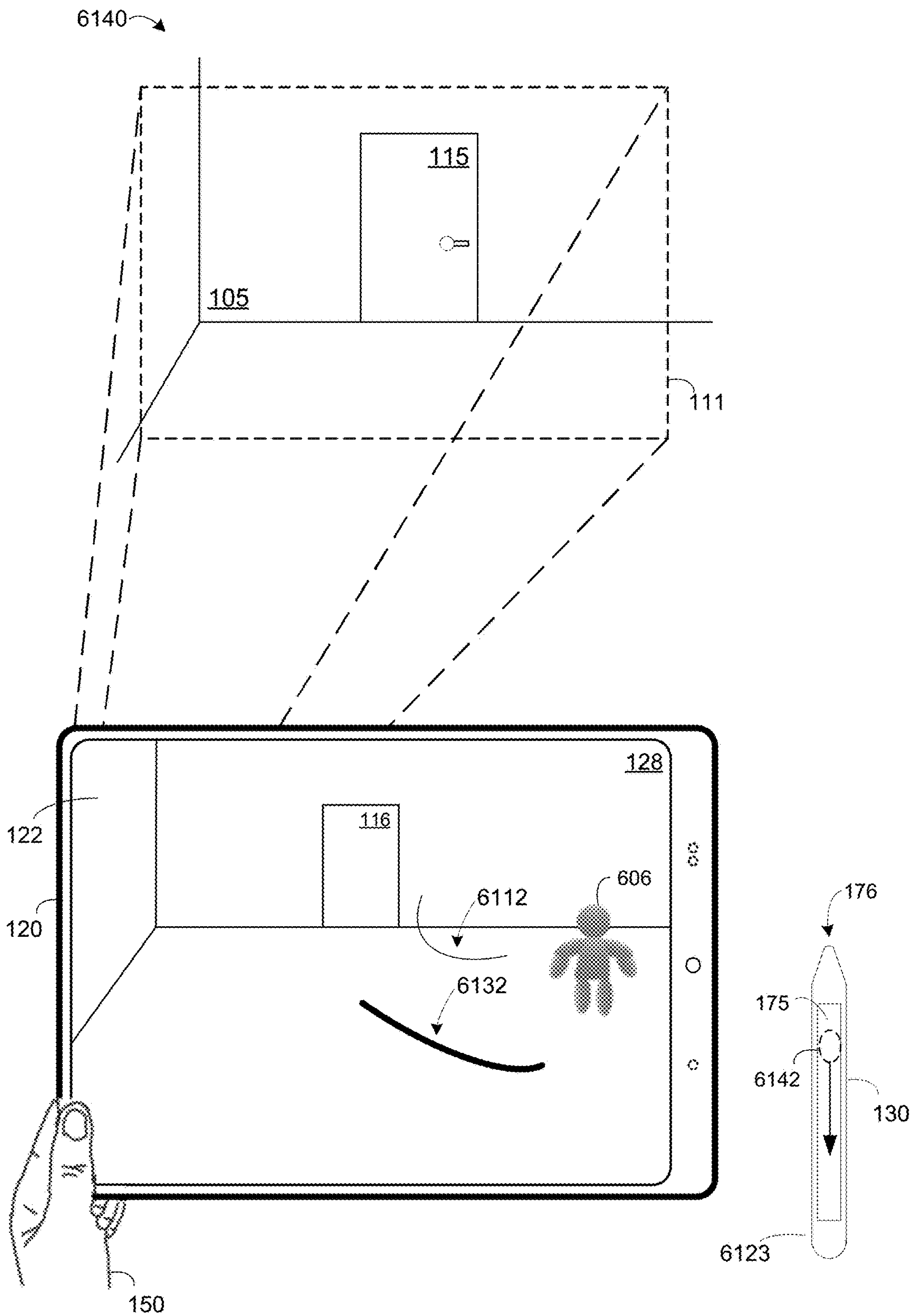
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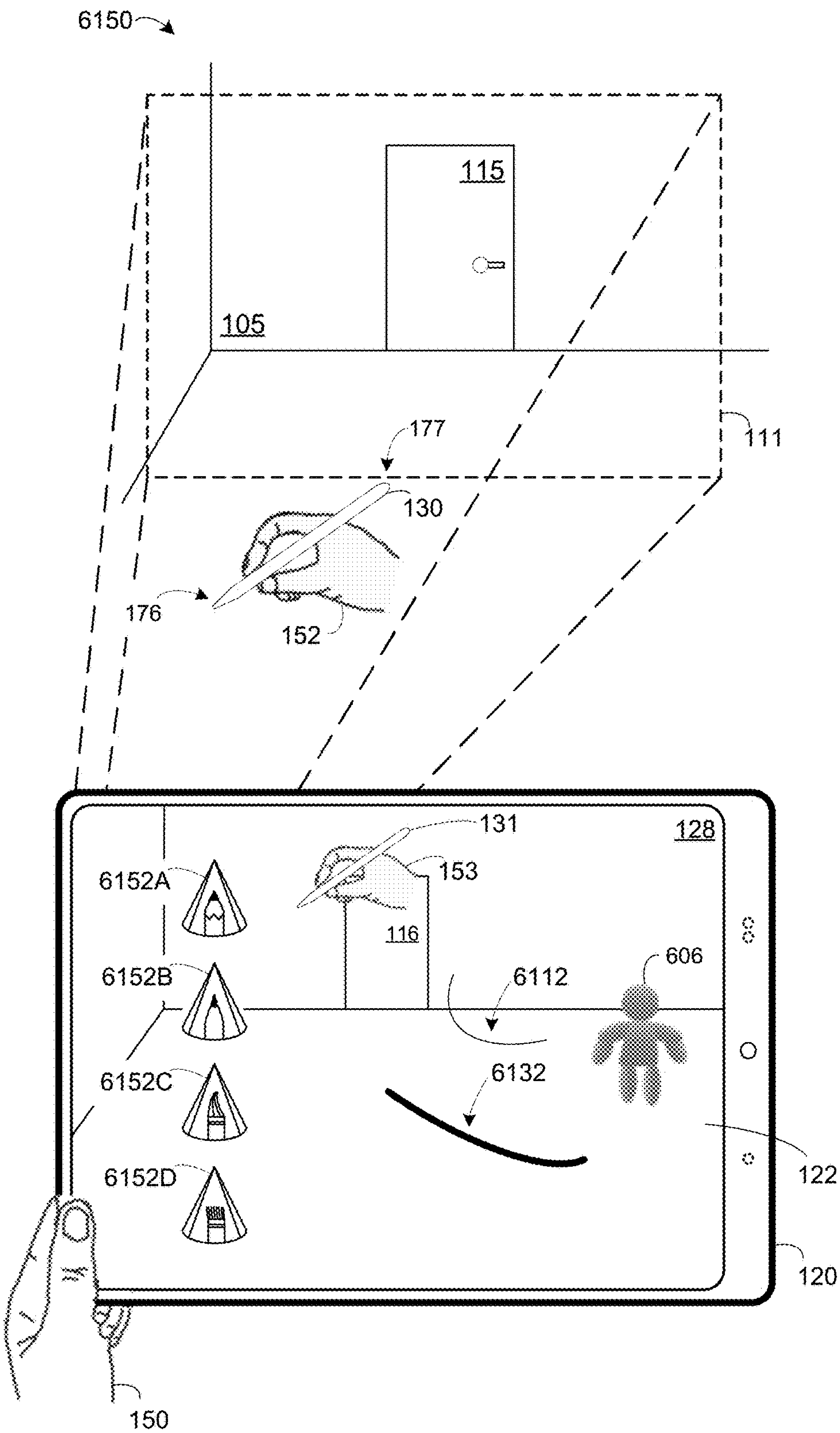
Figure 6N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6152C
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6152D
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150

Figure 6O

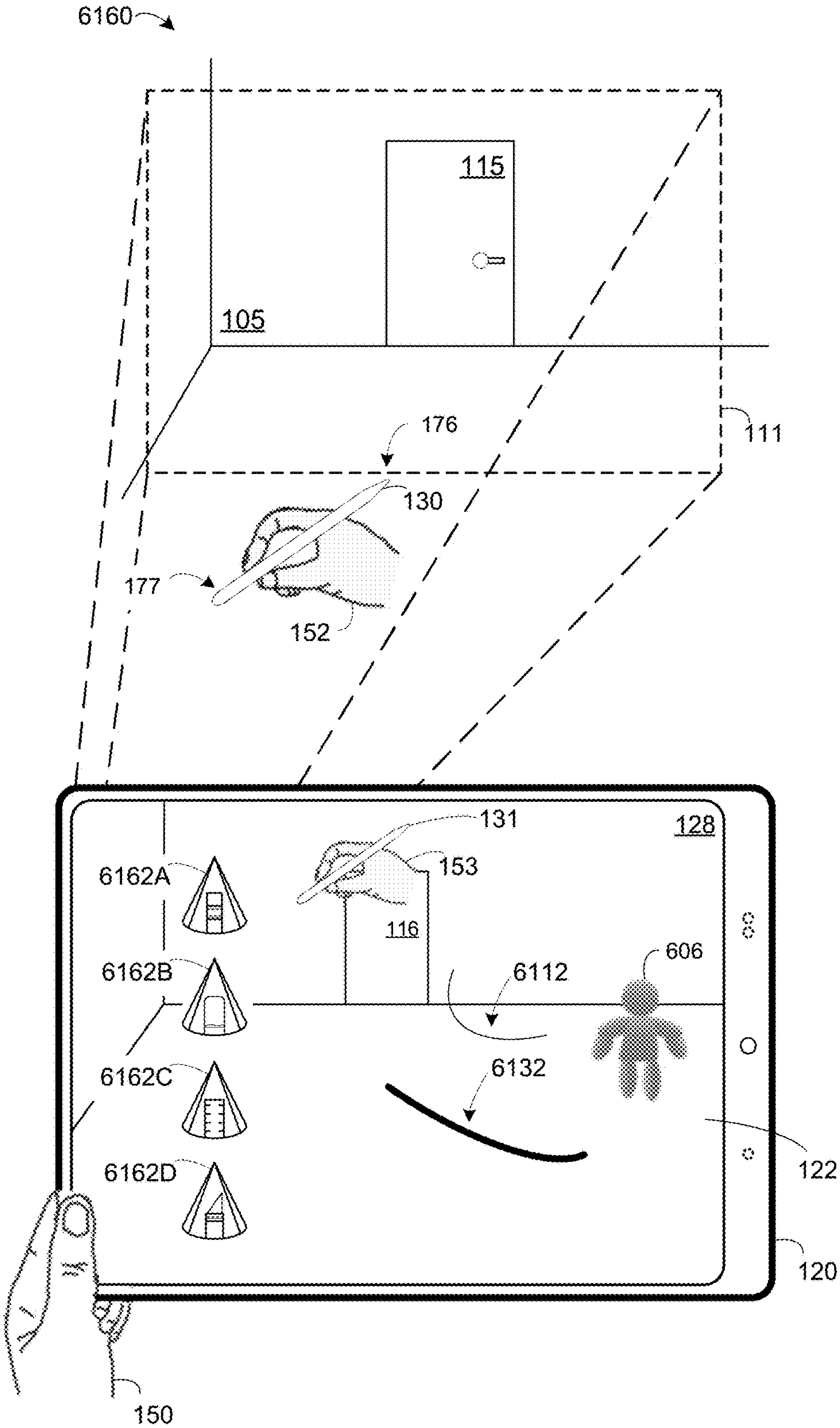
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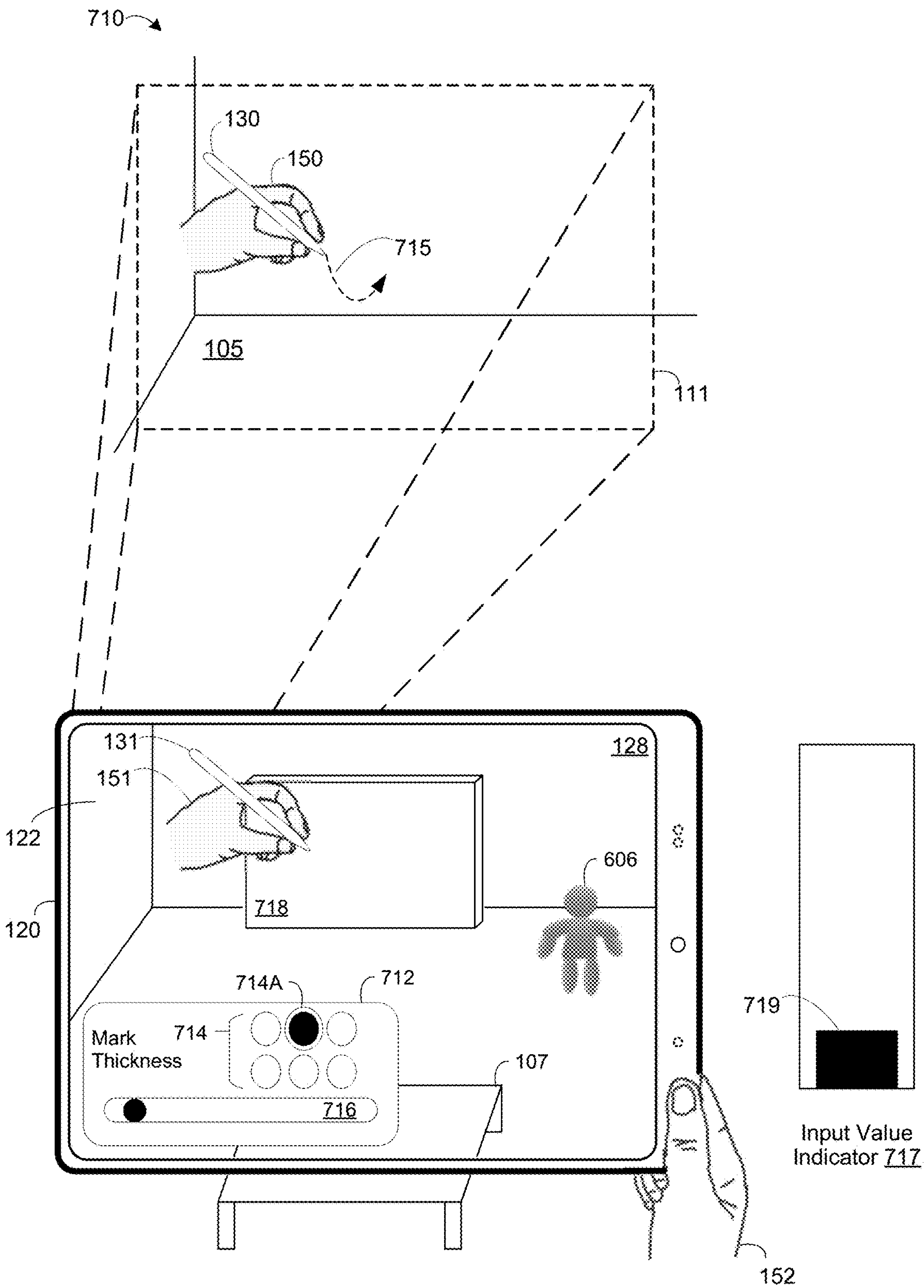
Figure 6P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Mark Thickness
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Input Value Indicator 717
152

Figure 7A

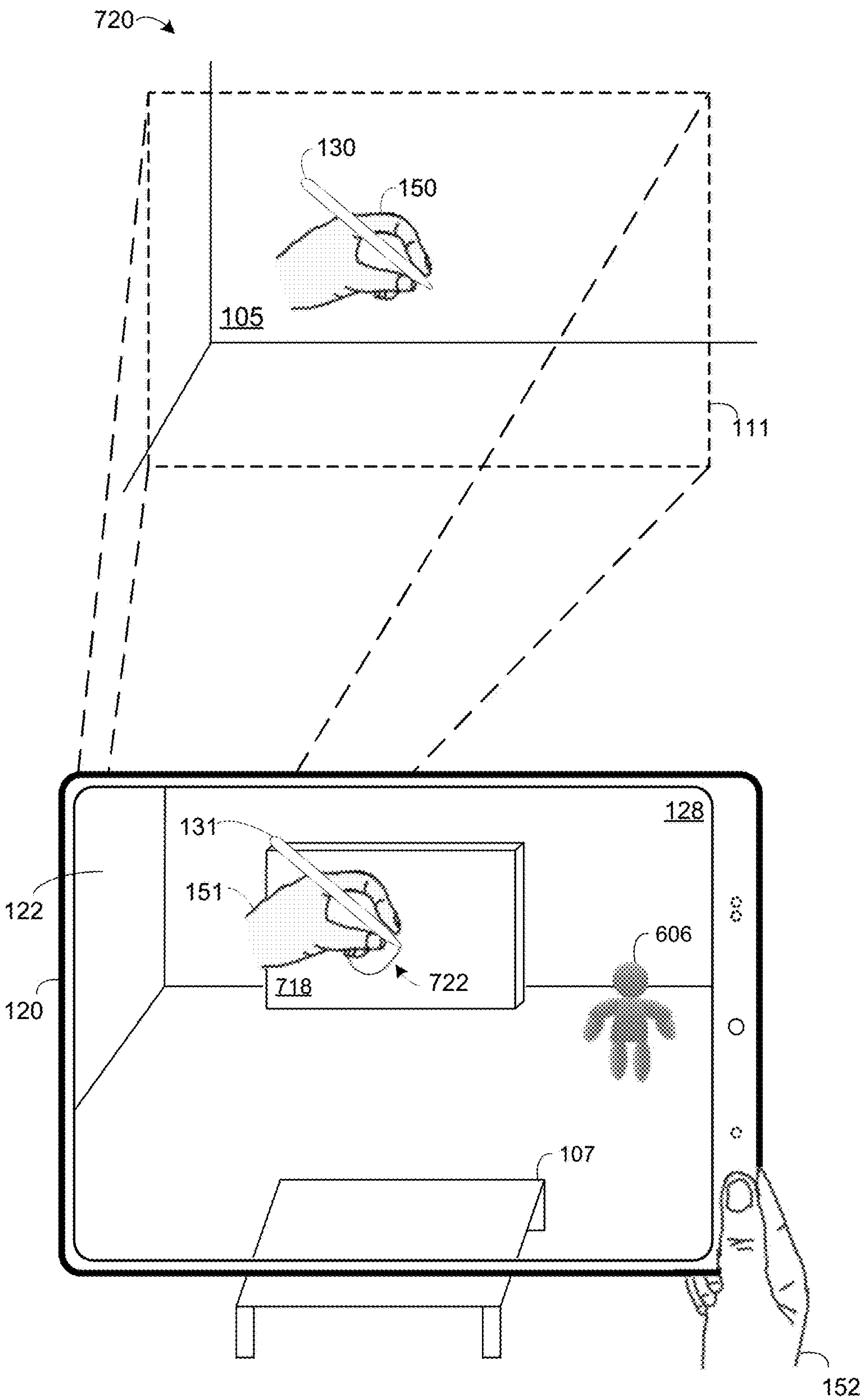
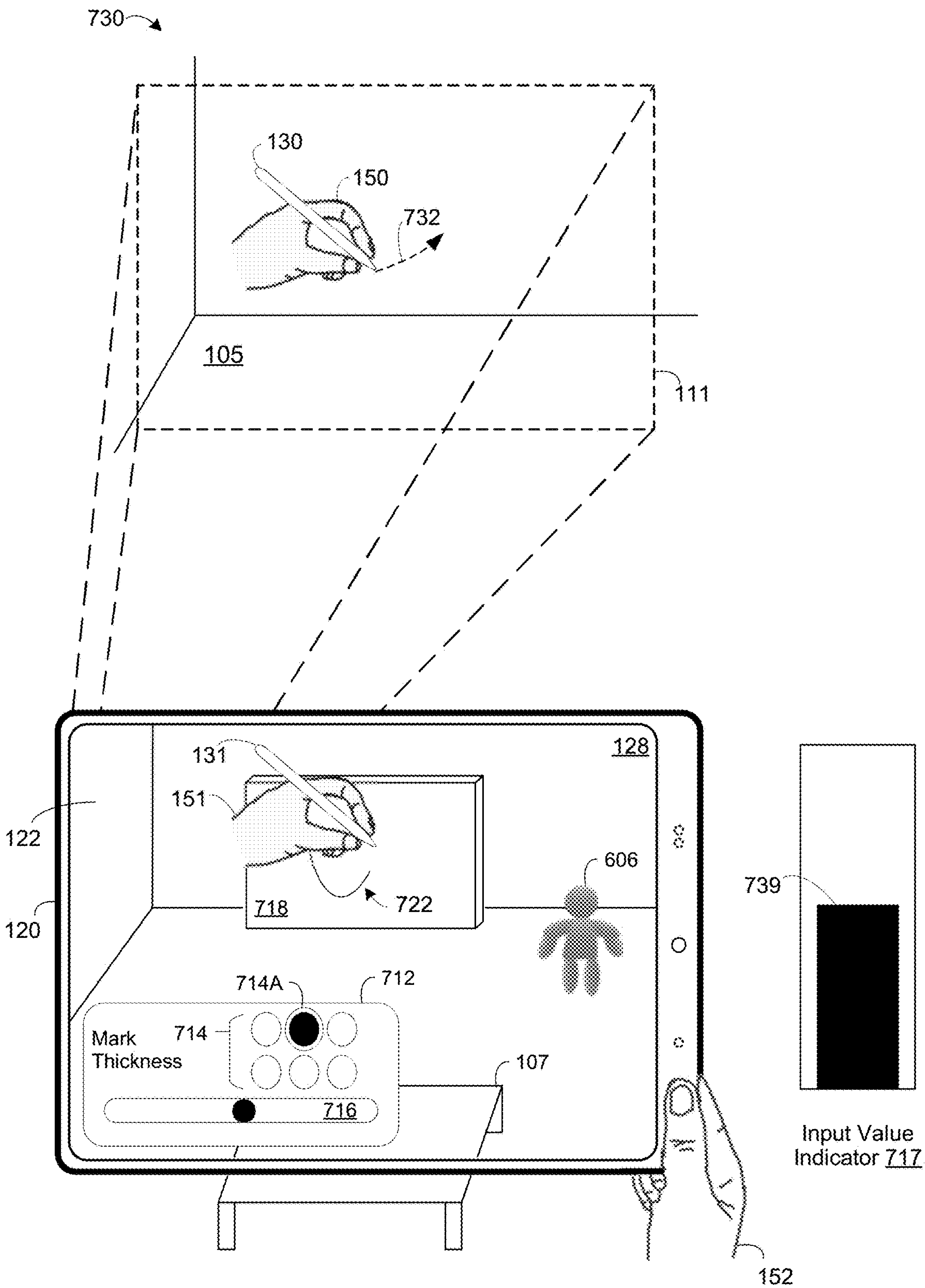


Figure 7B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Thickness
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107
716
Input Value
Indicator 717
152

Figure 7C

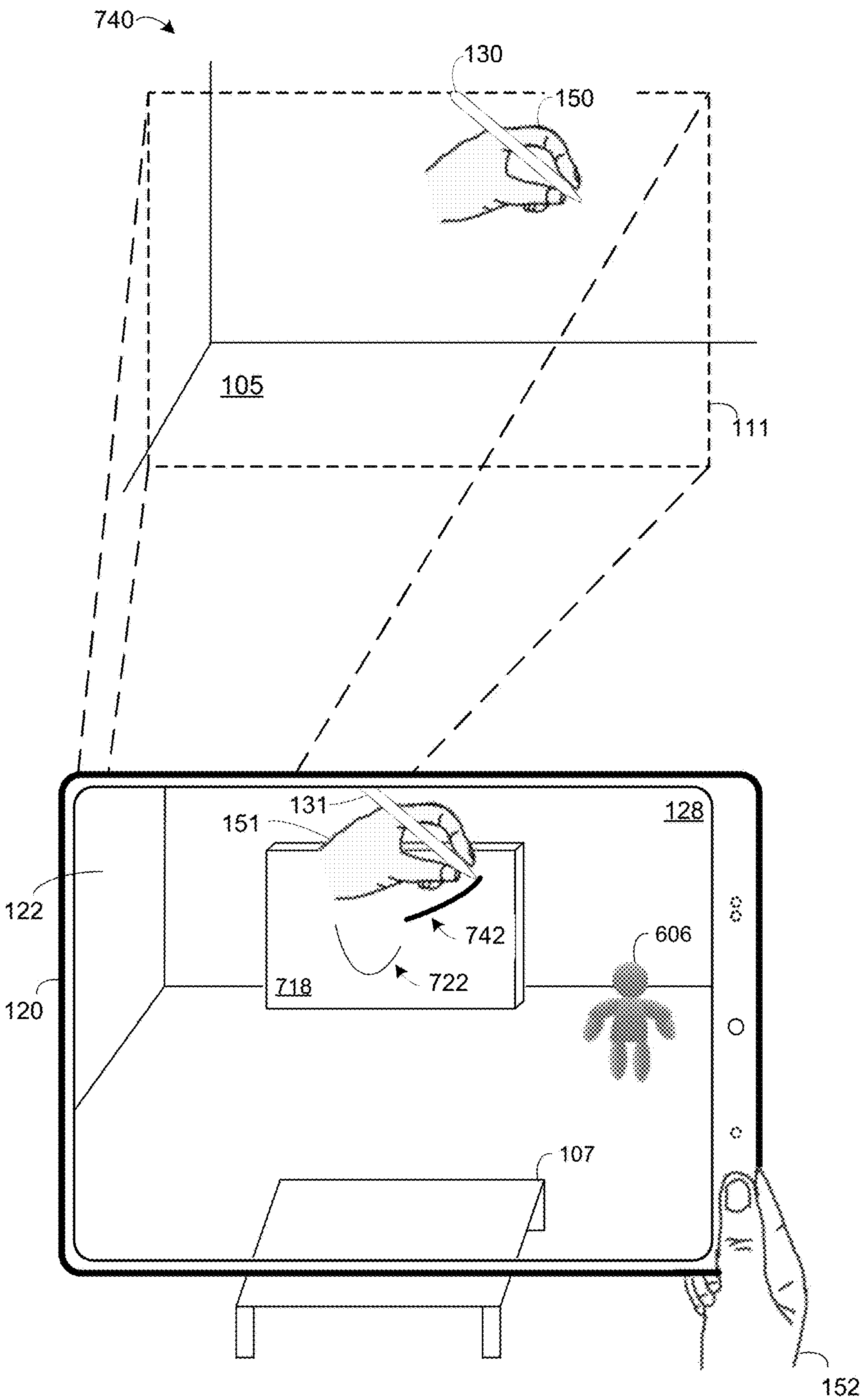

Figure 7D

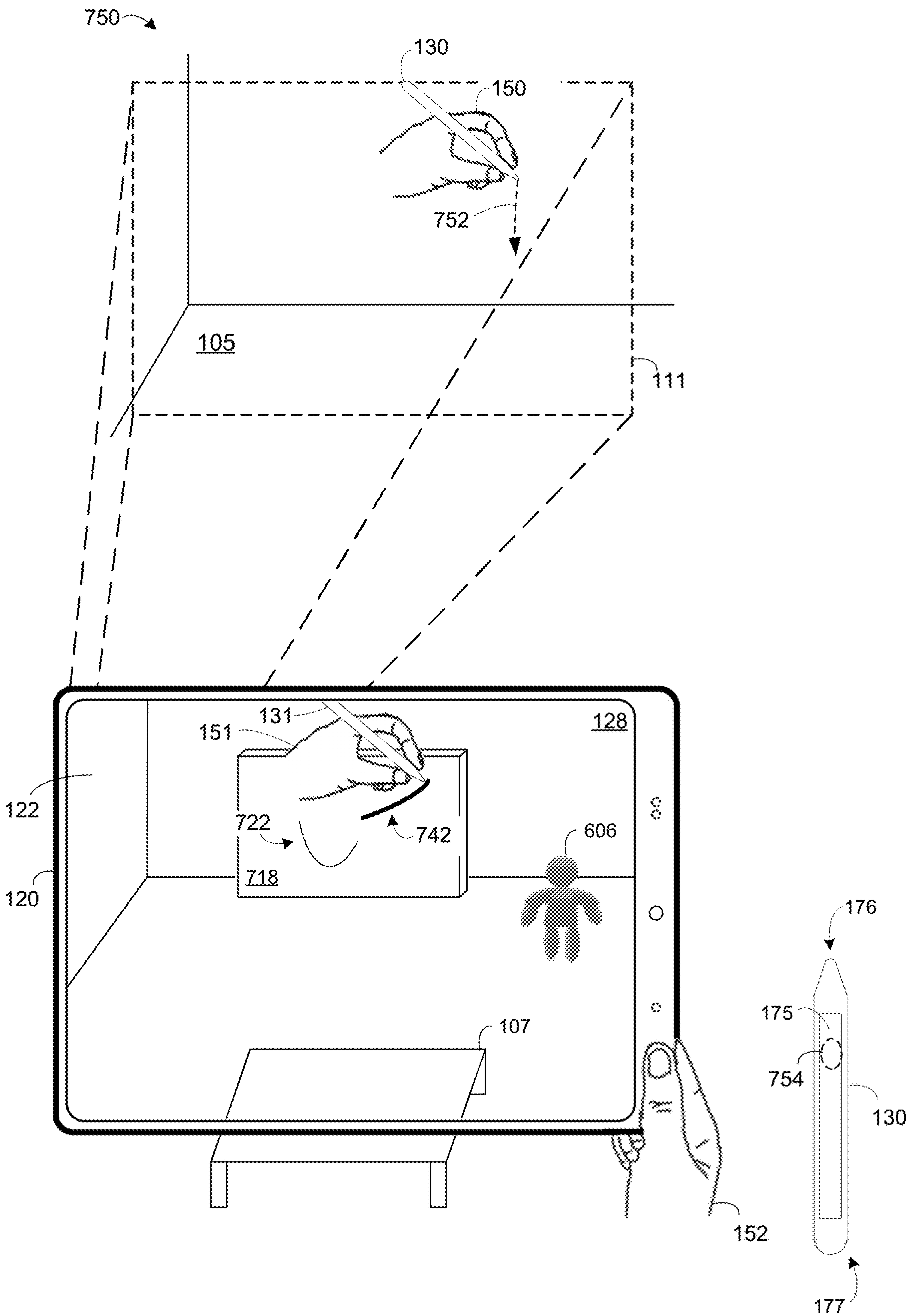
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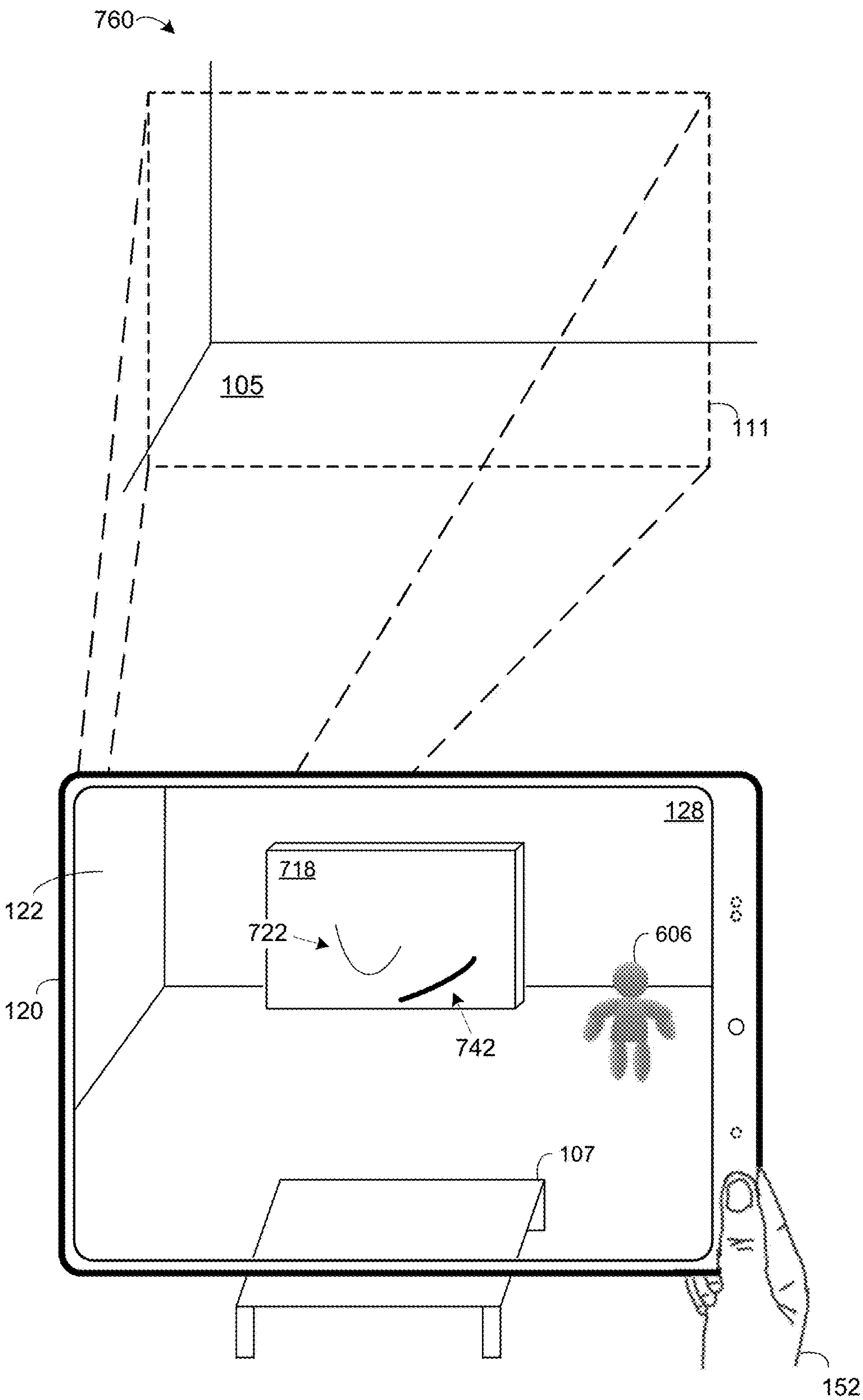
Figure 7E



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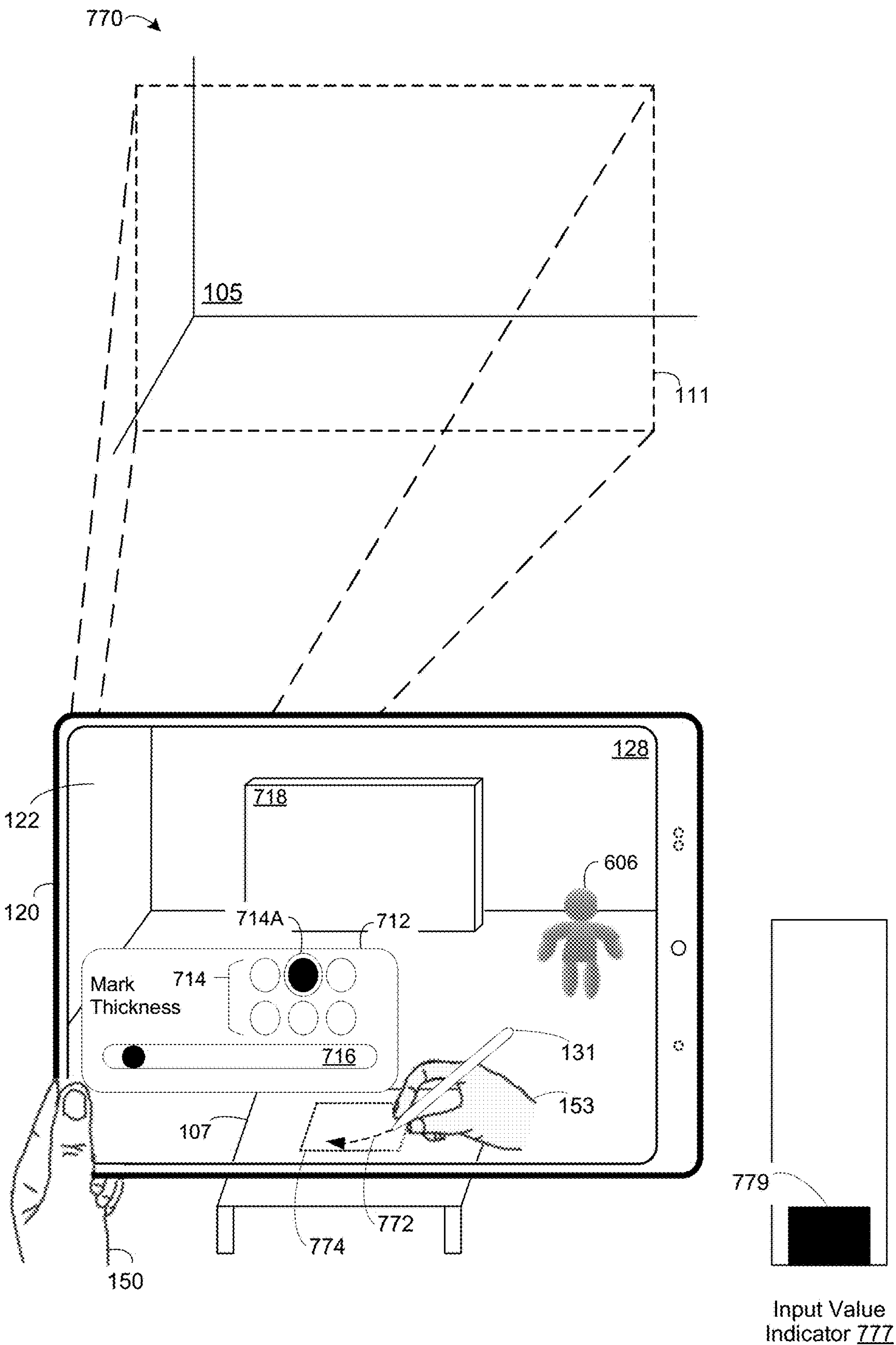
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Indicator 777

Figure 7G

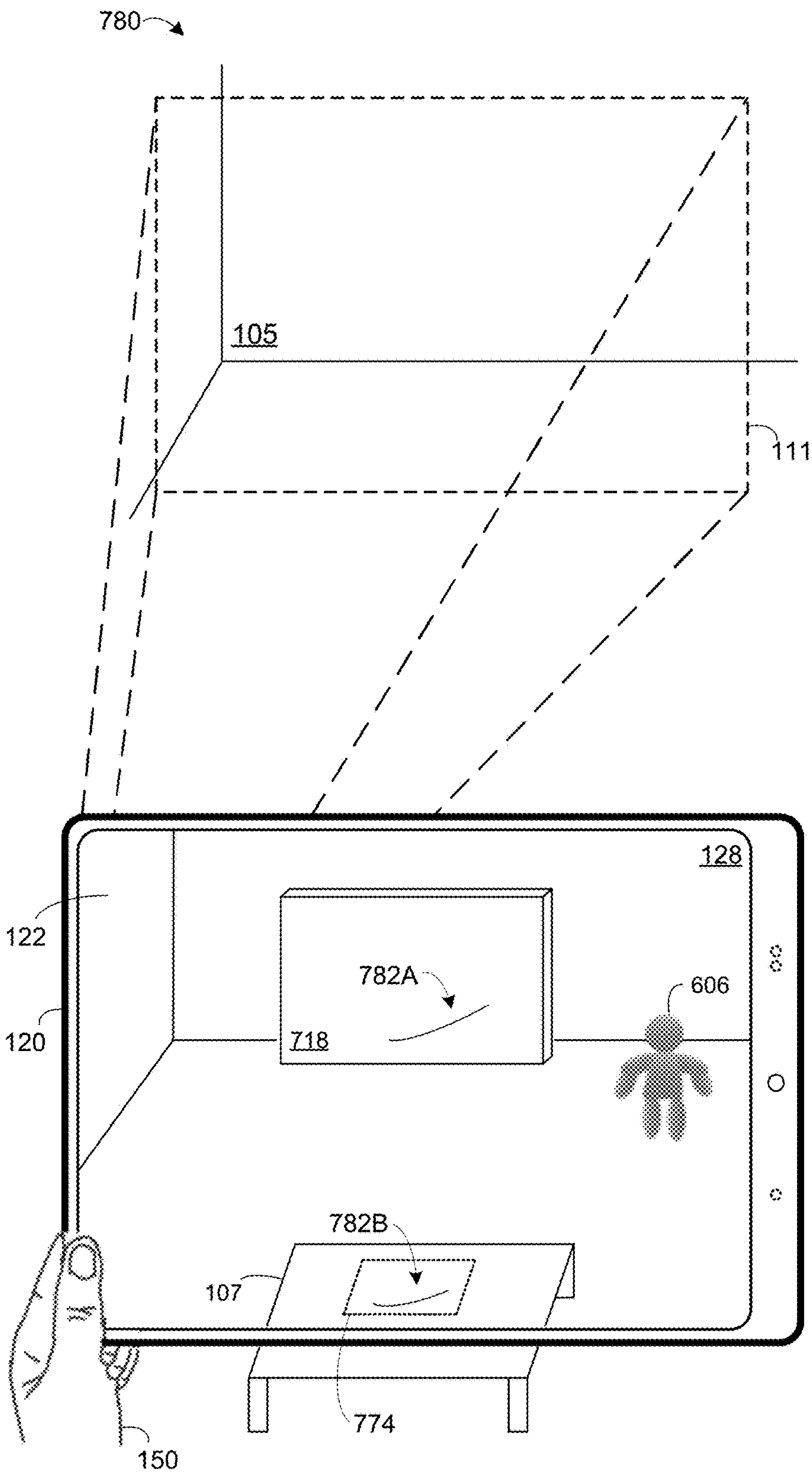
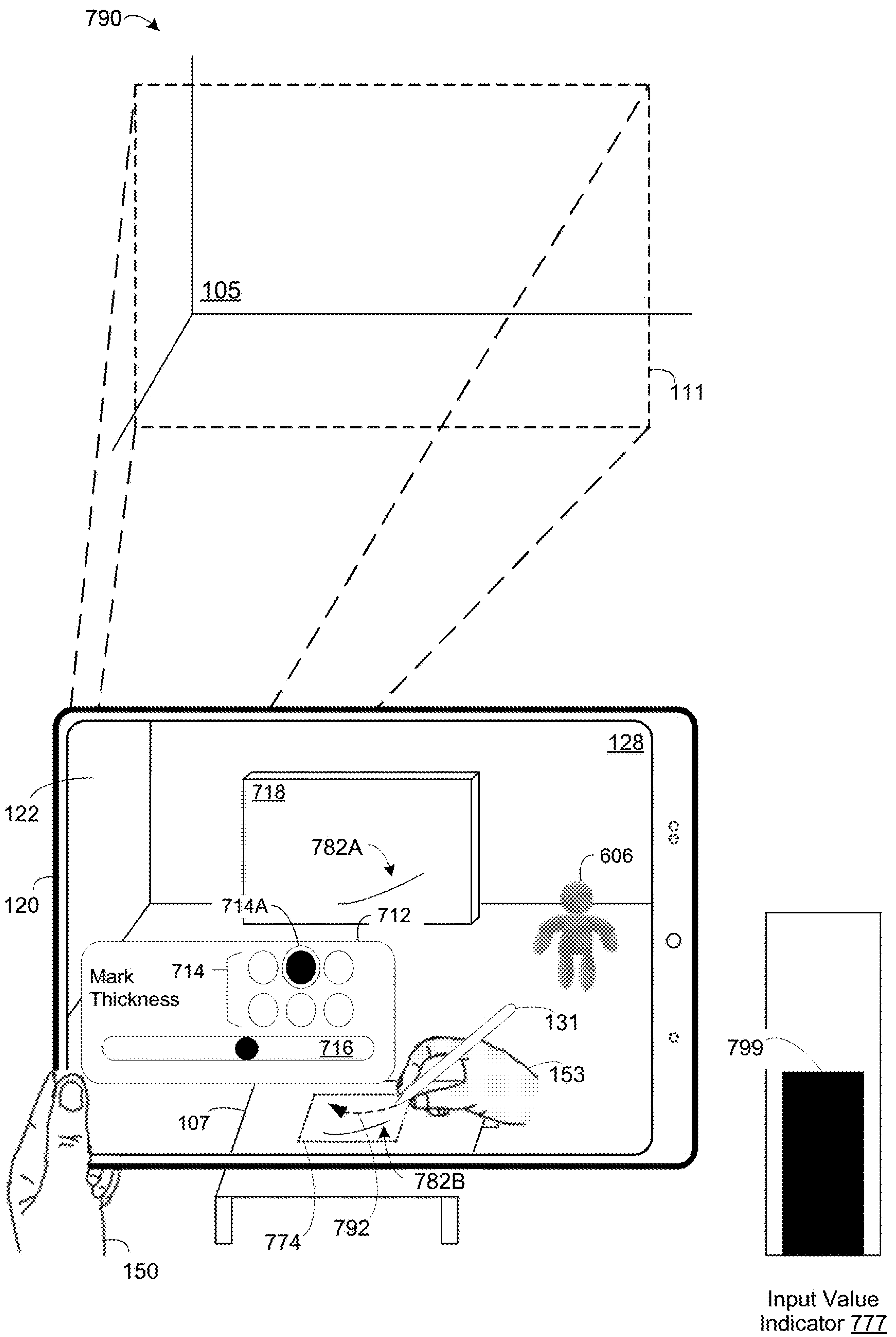


Figure 7H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Input Value Indicator 777

Figure 7I

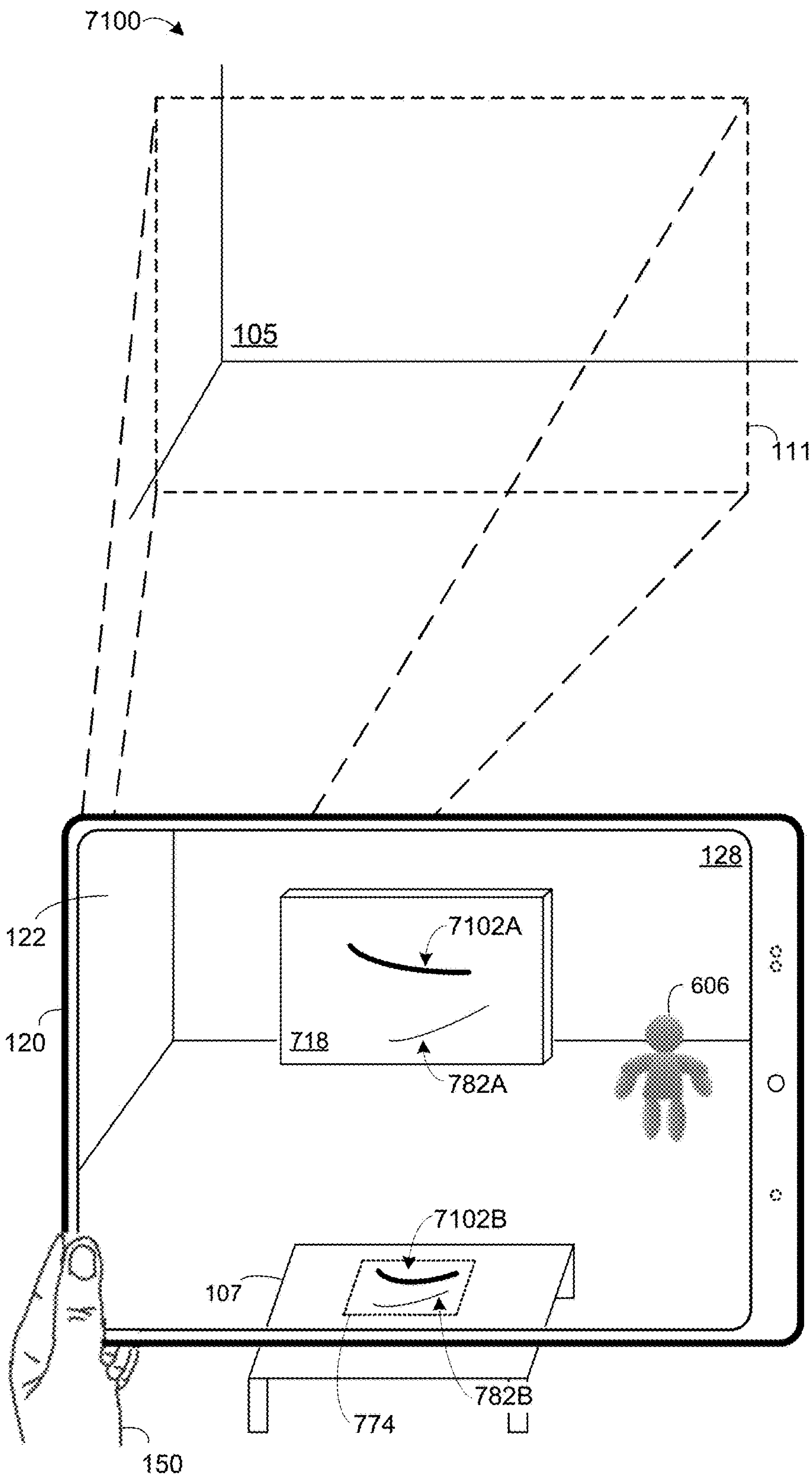
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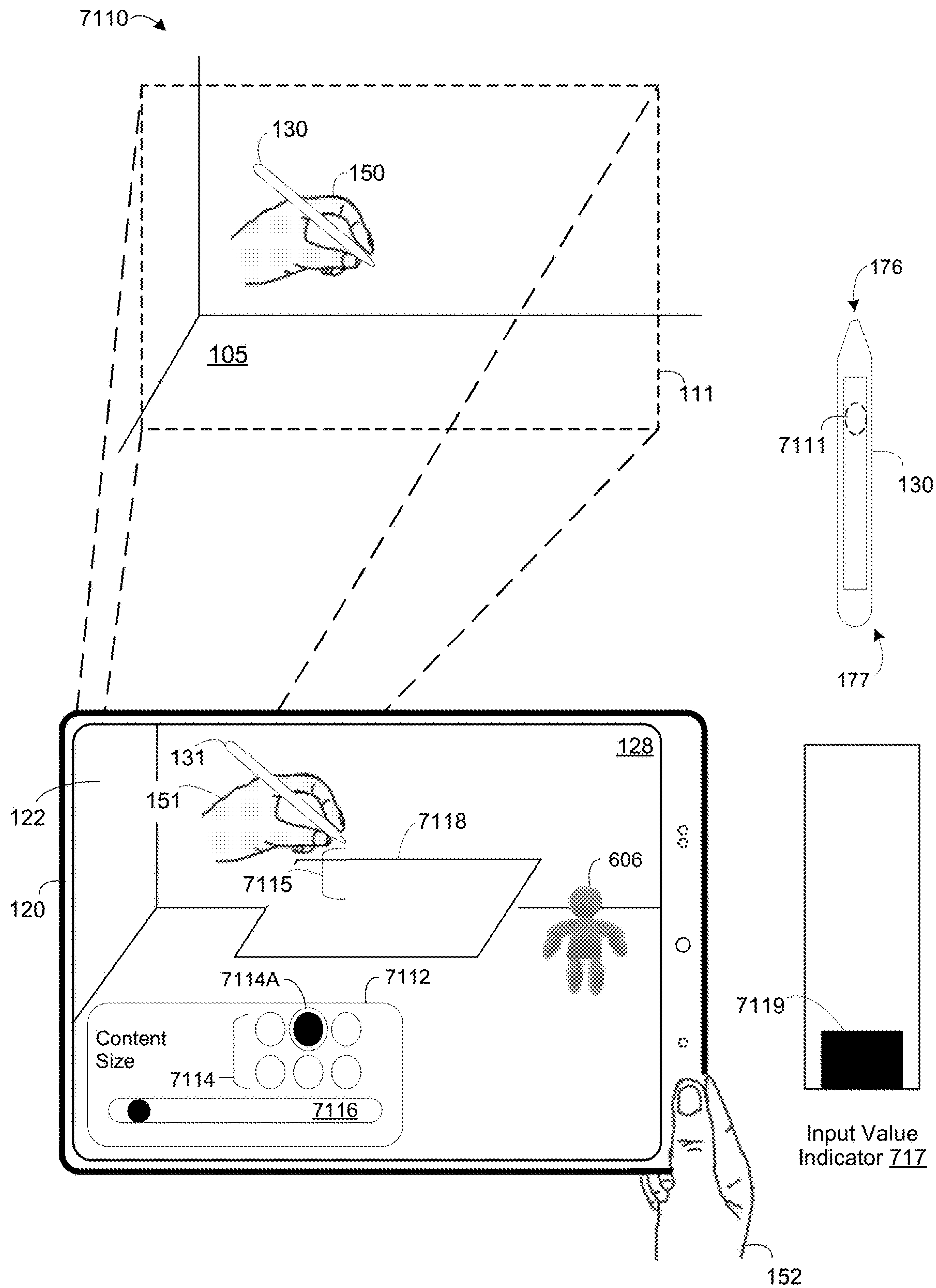
Figure 7J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Content Size
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152

Figure 7K

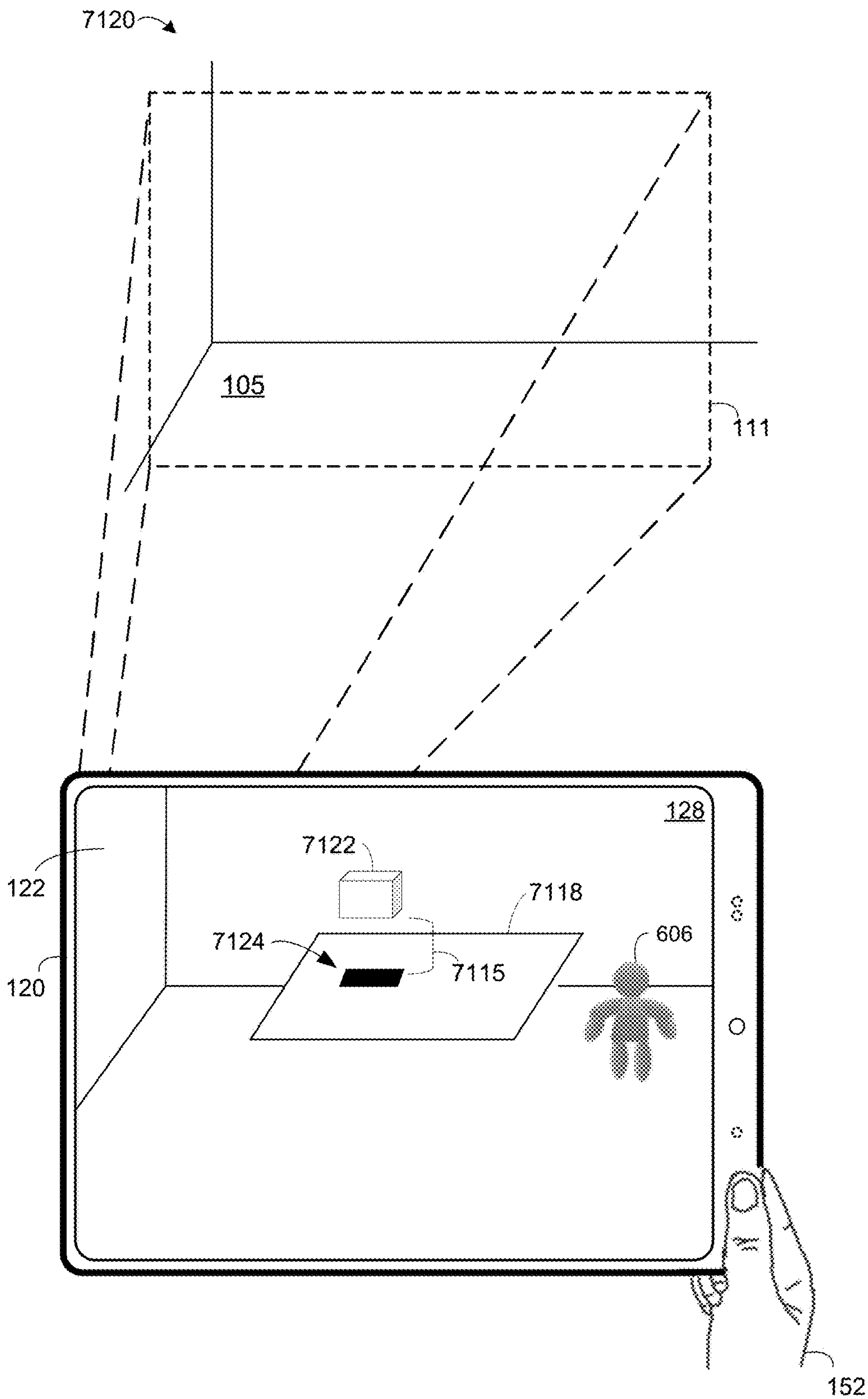
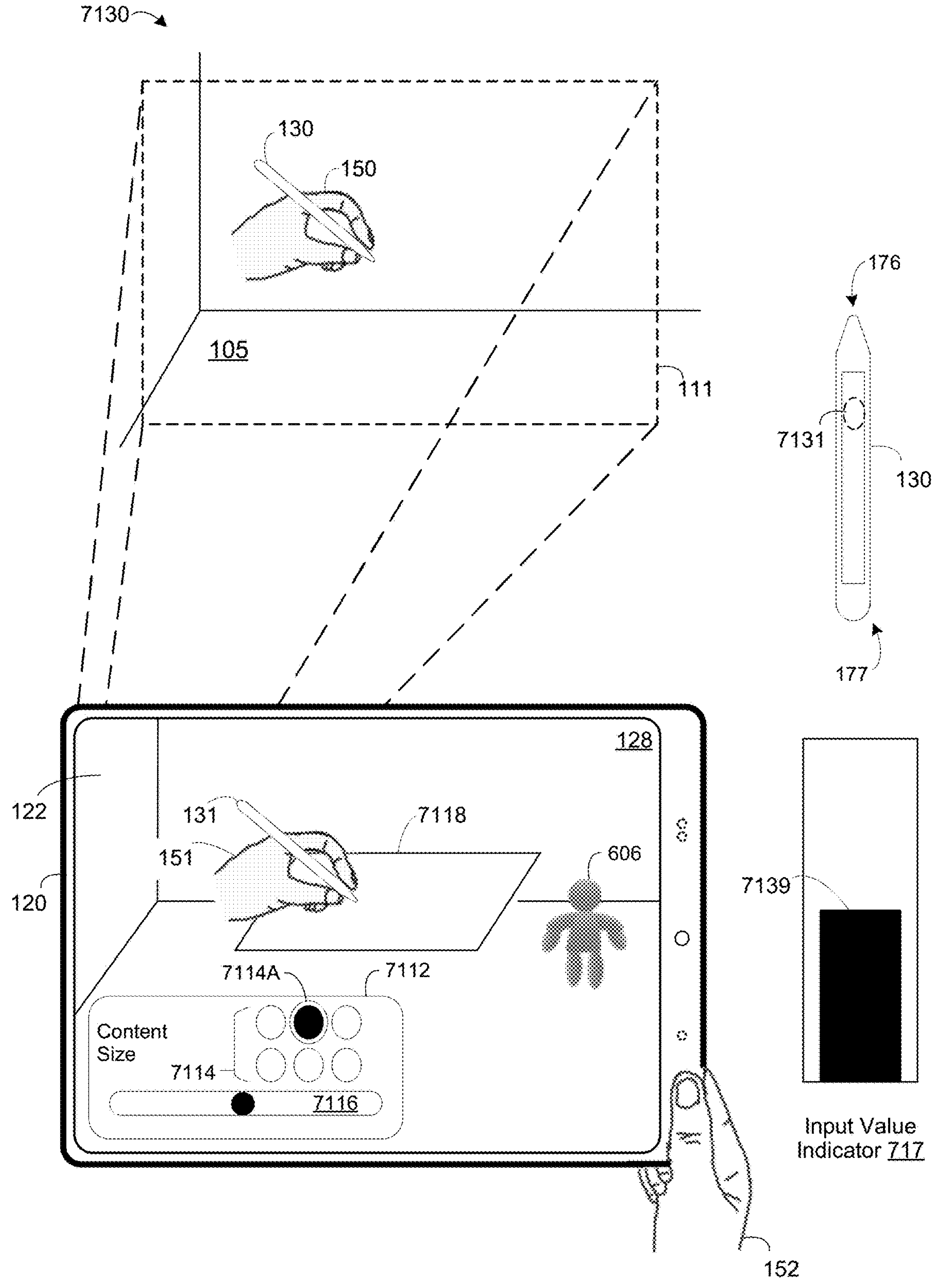


Figure 7L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Indicator 717
152

Figure 7M

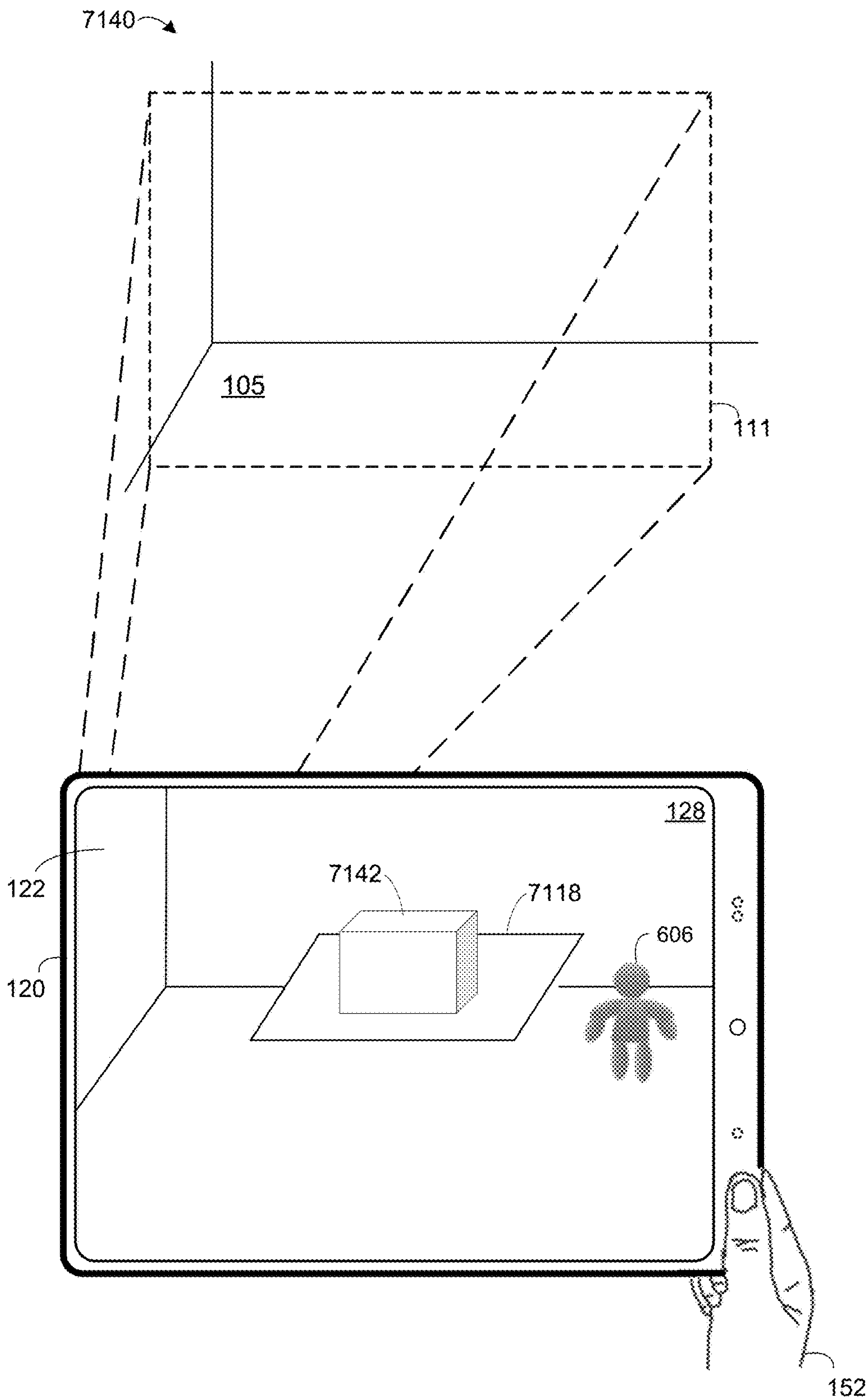

Figure 7N

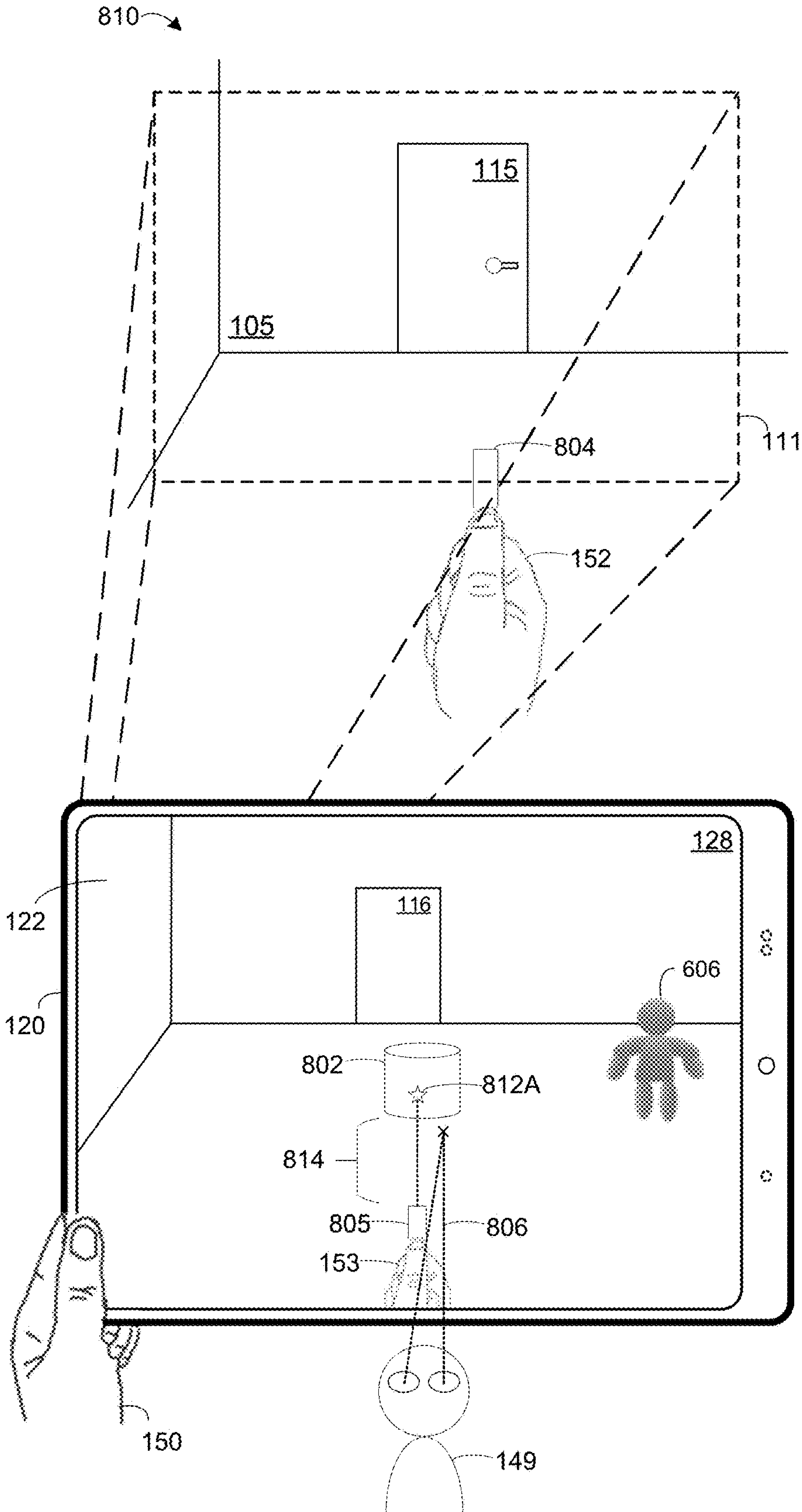
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Figure 8A

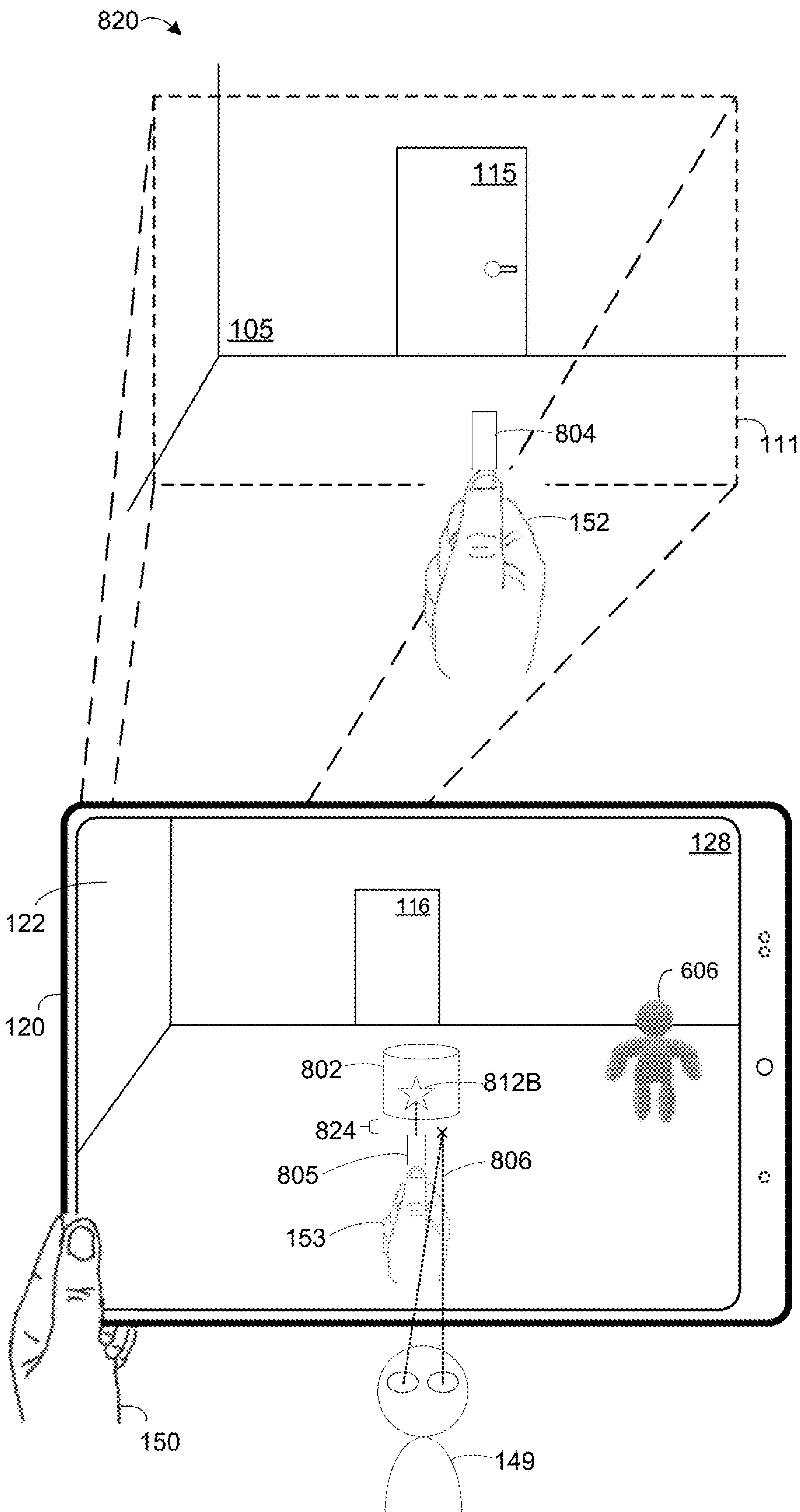
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Figure 8B

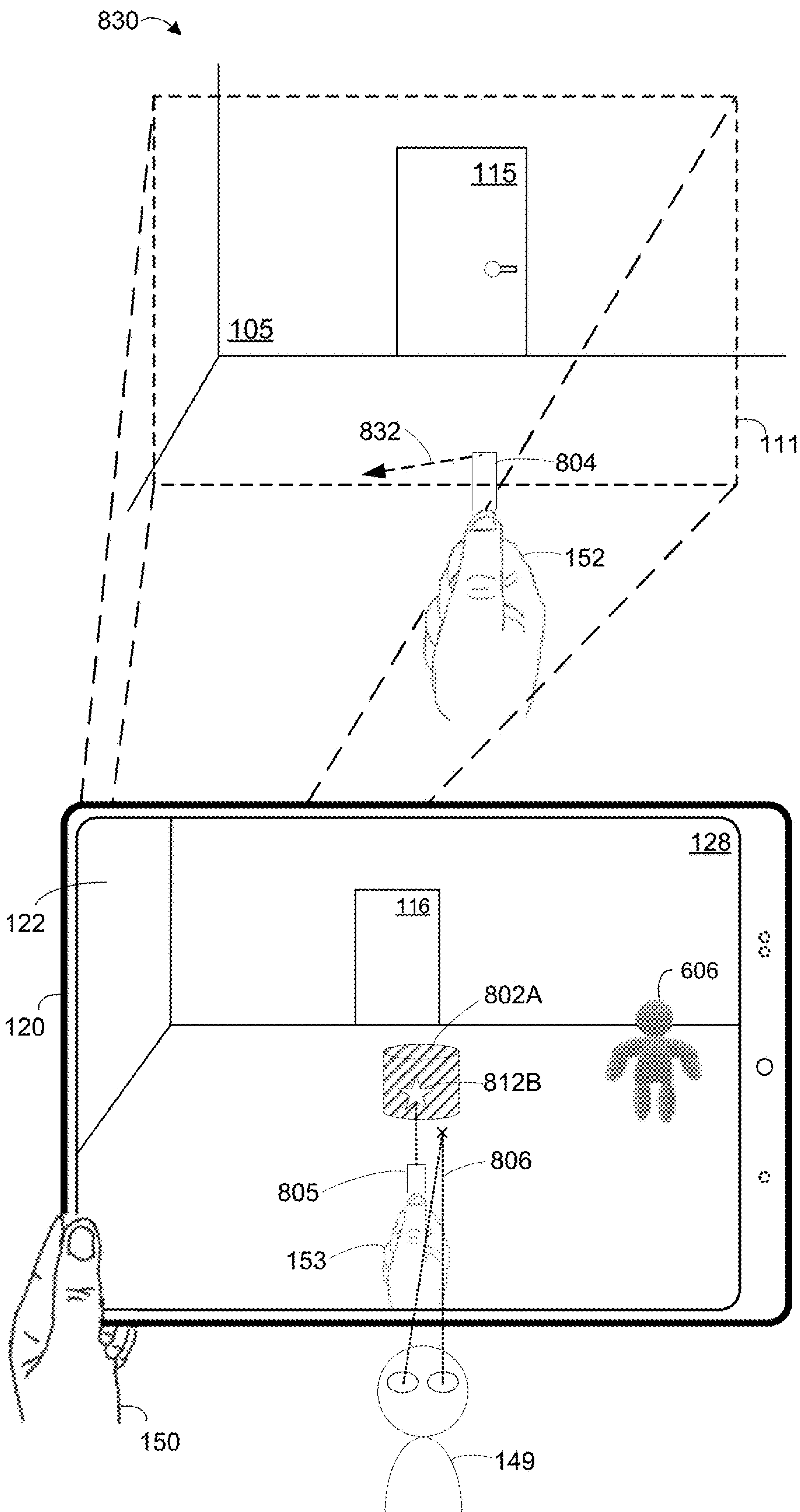
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Figure 8C

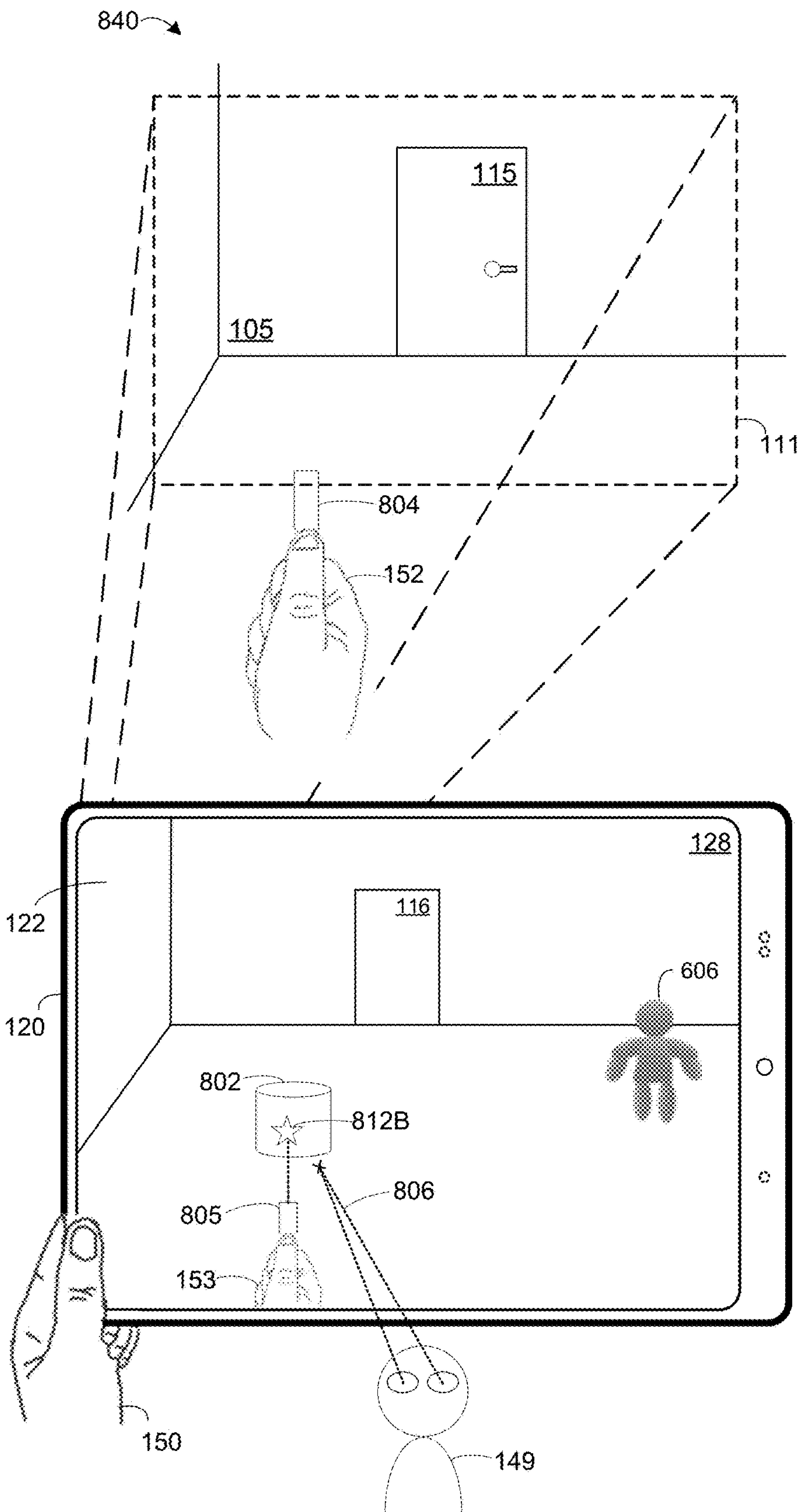
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Figure 8D

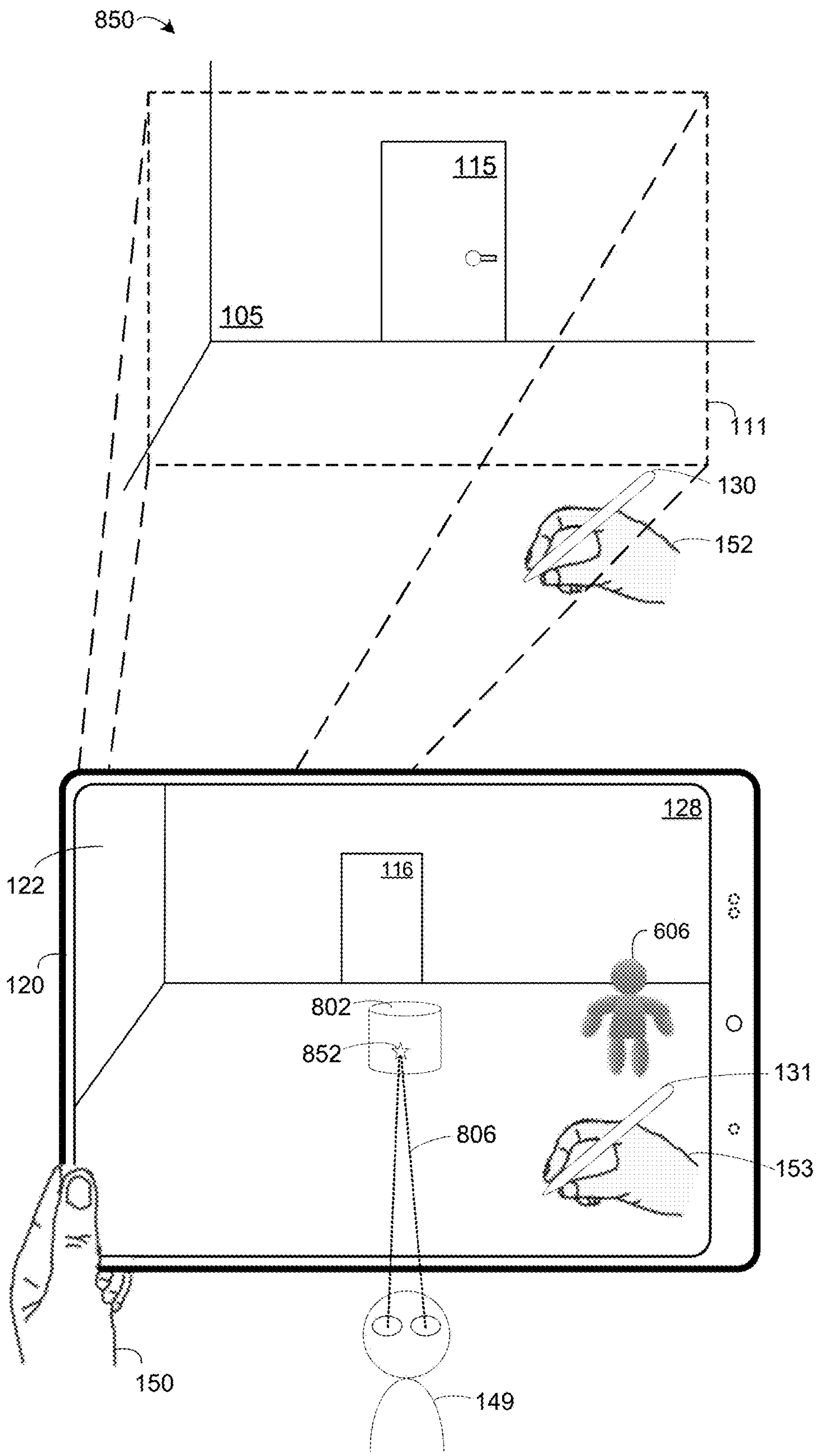
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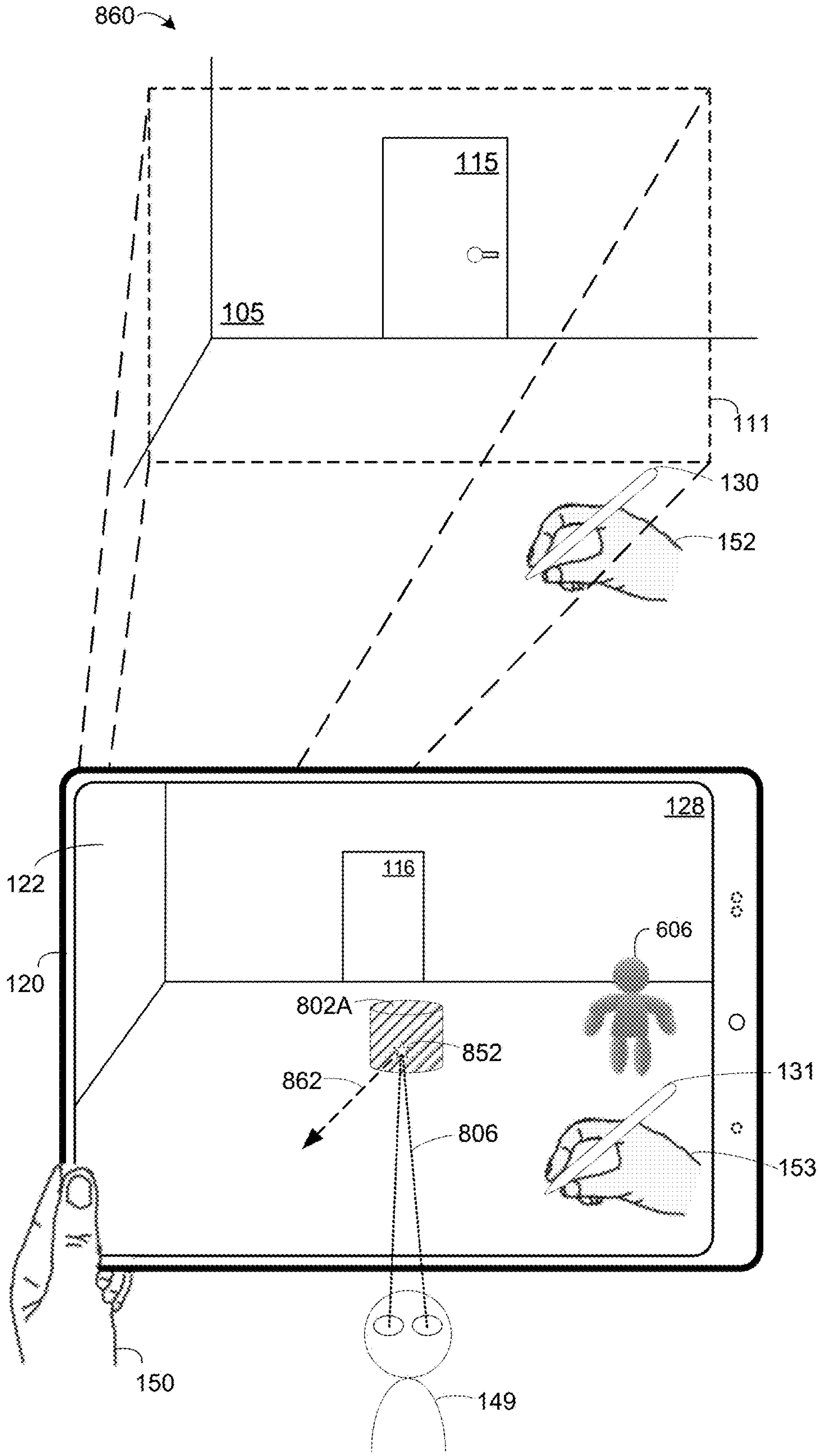
Figure 8E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122
120
606
802A
852
862
131
806
153
150
149

Figure 8F

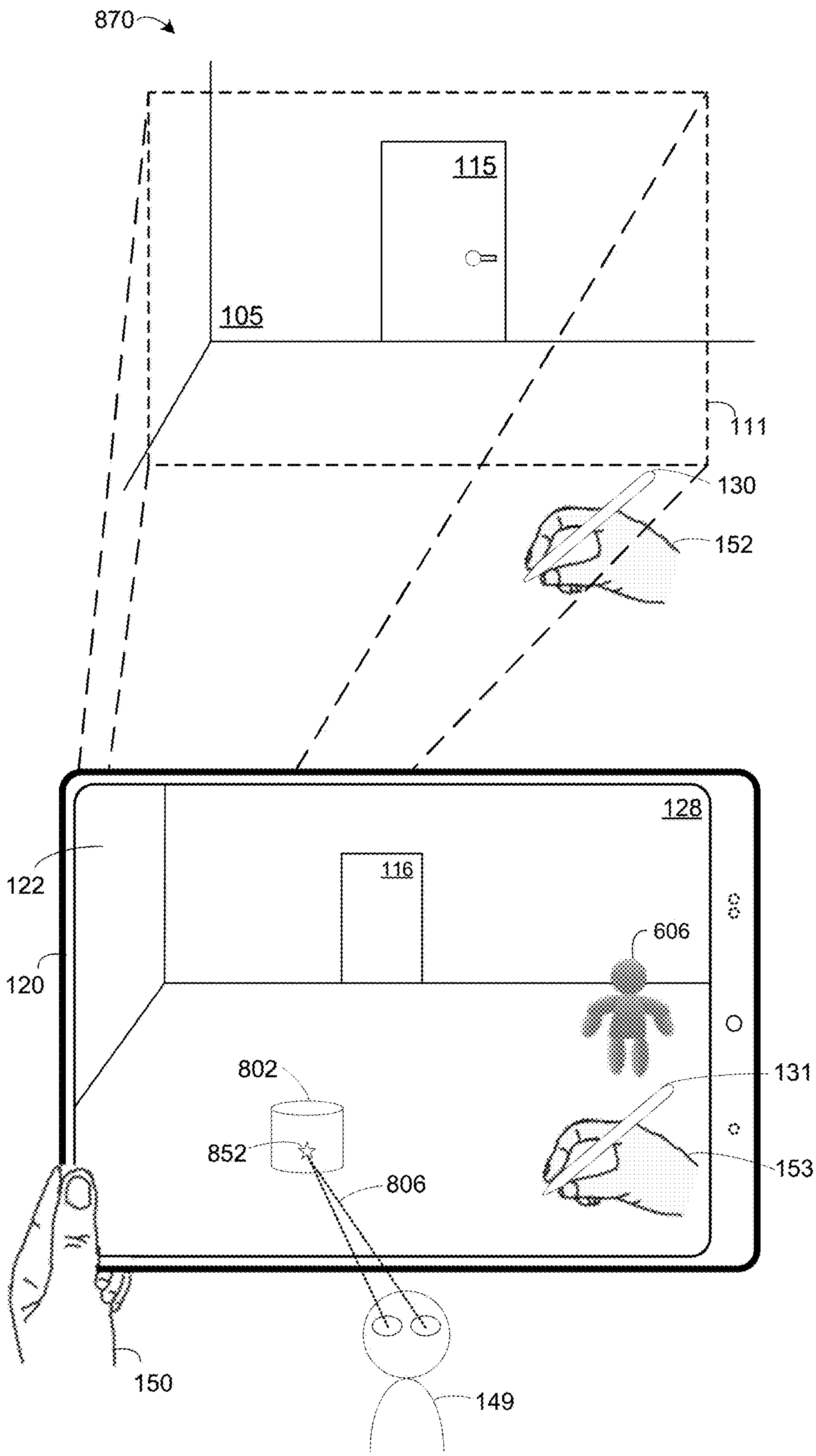
870
115
105
111
130
152
128
116
122
606
120
802
131
852
806
153
150
149

Figure 8G

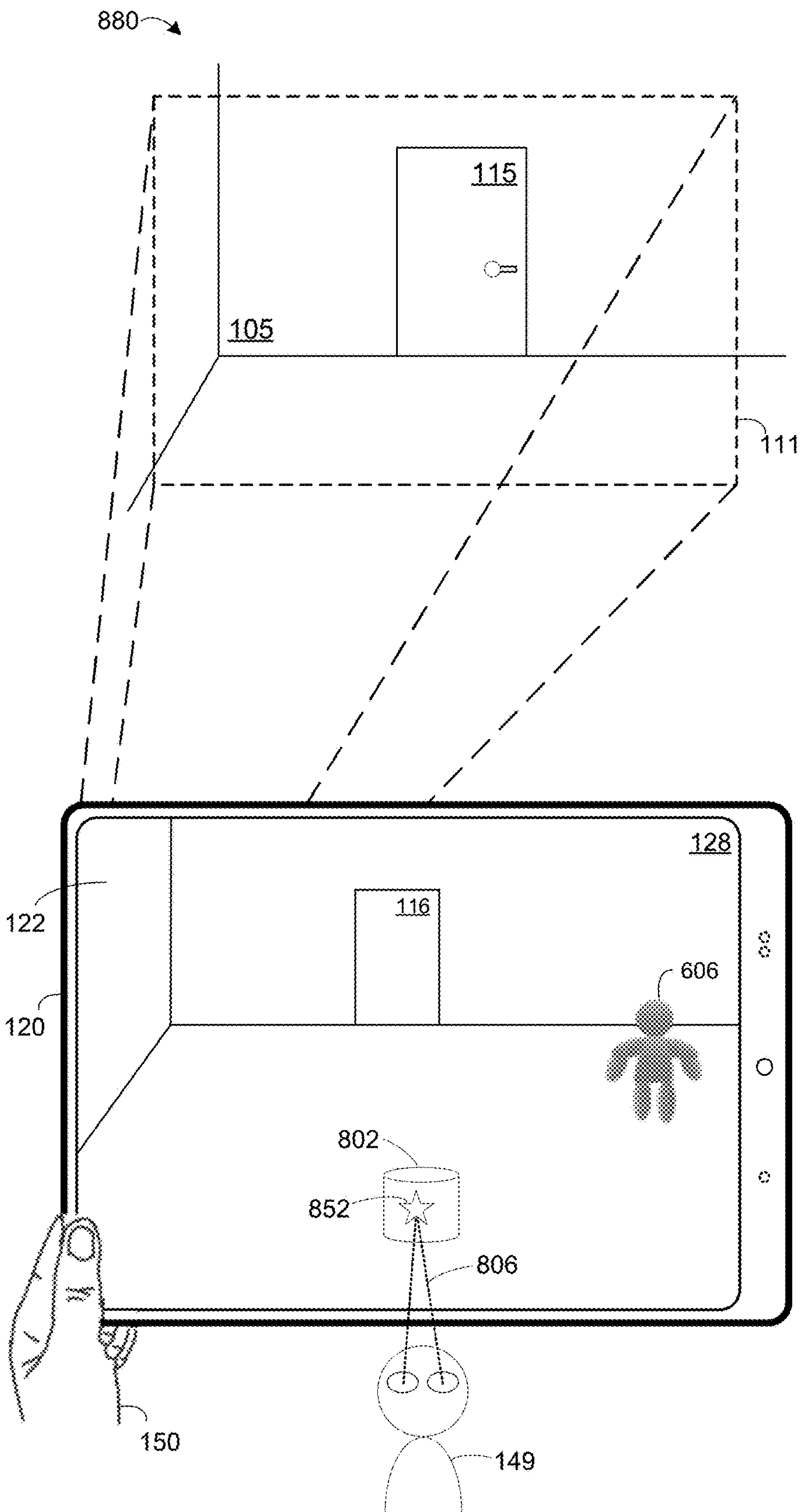

Figure 8H

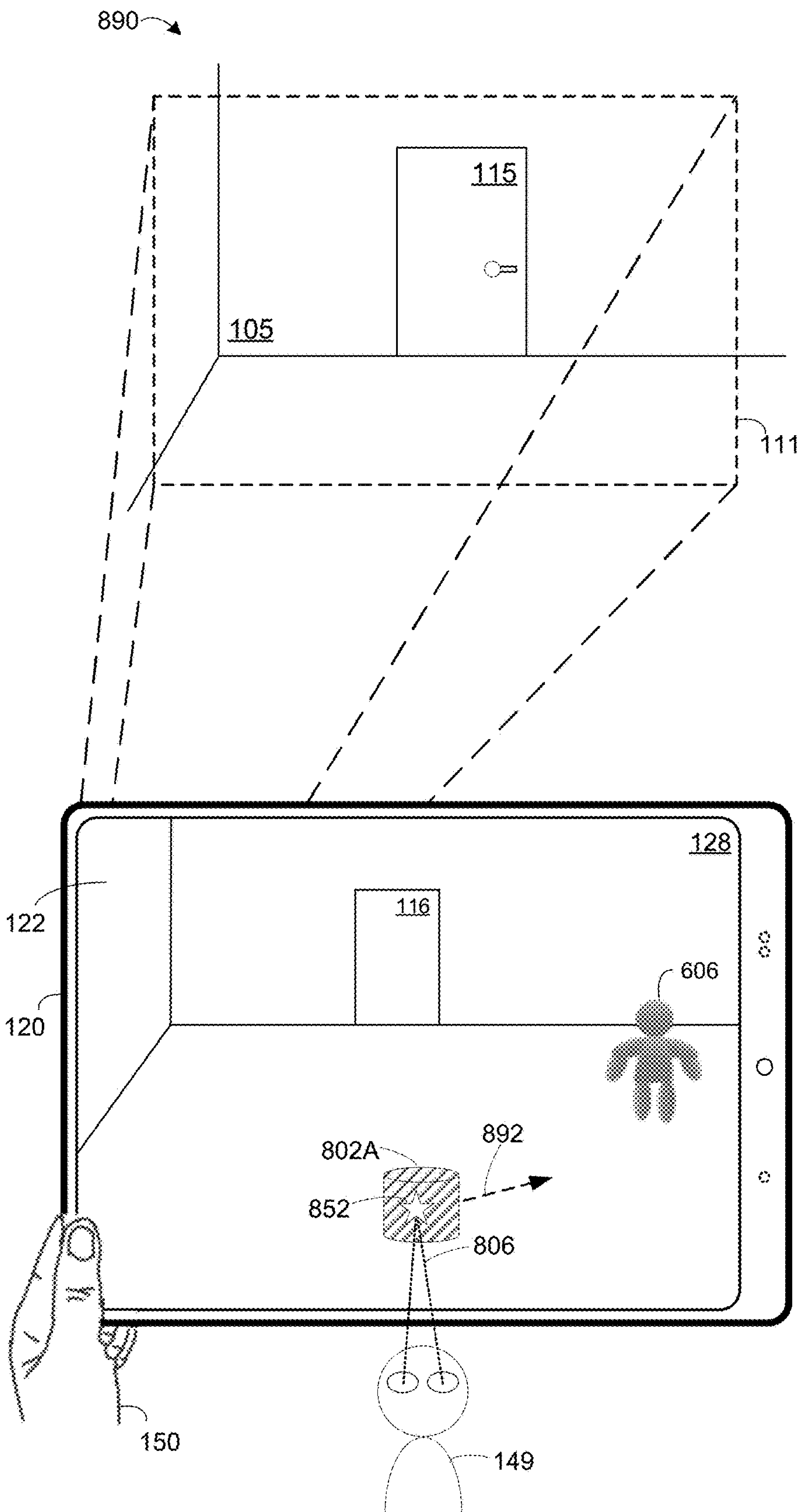

Figure 8I

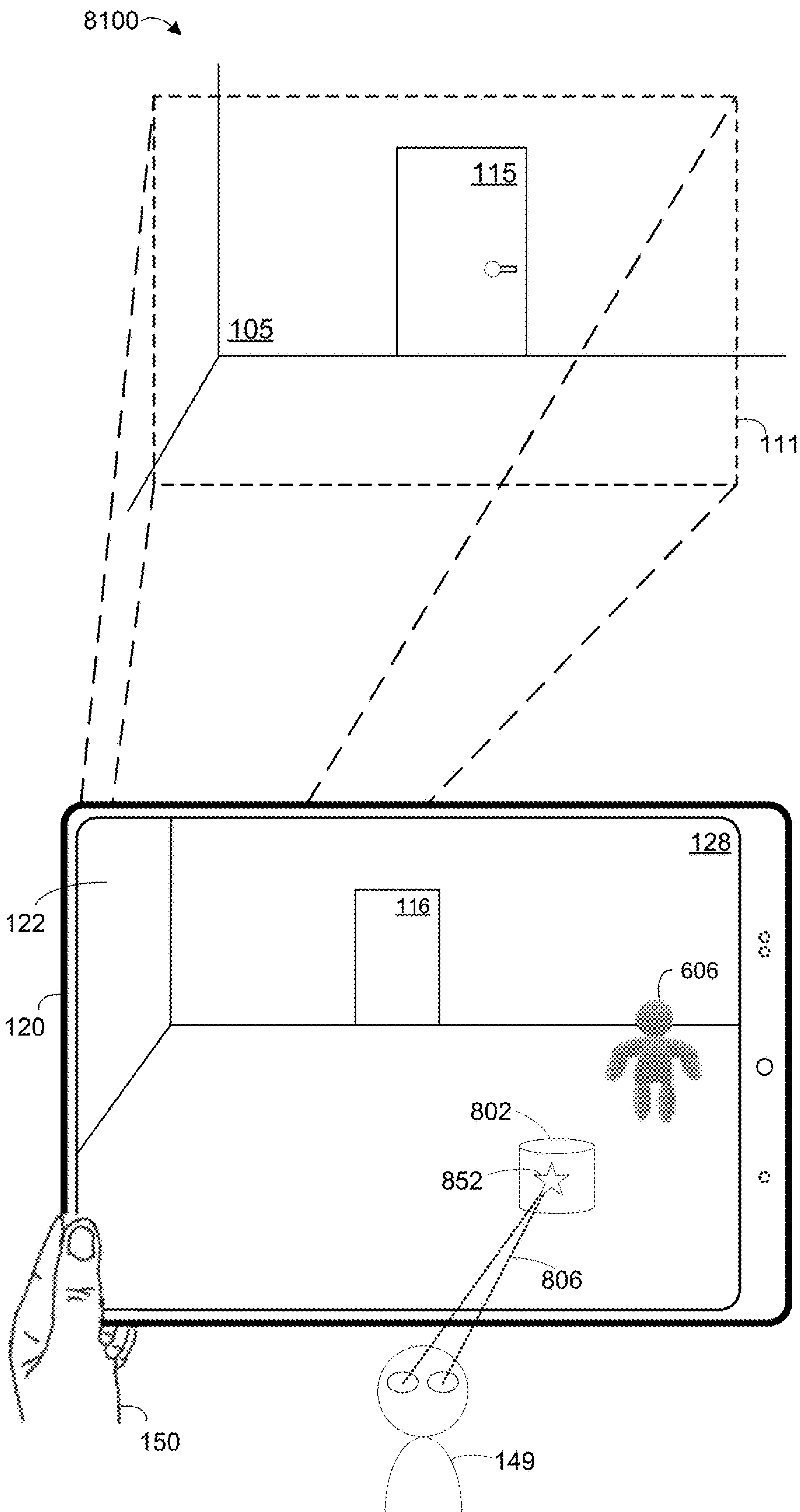

Figure 8J

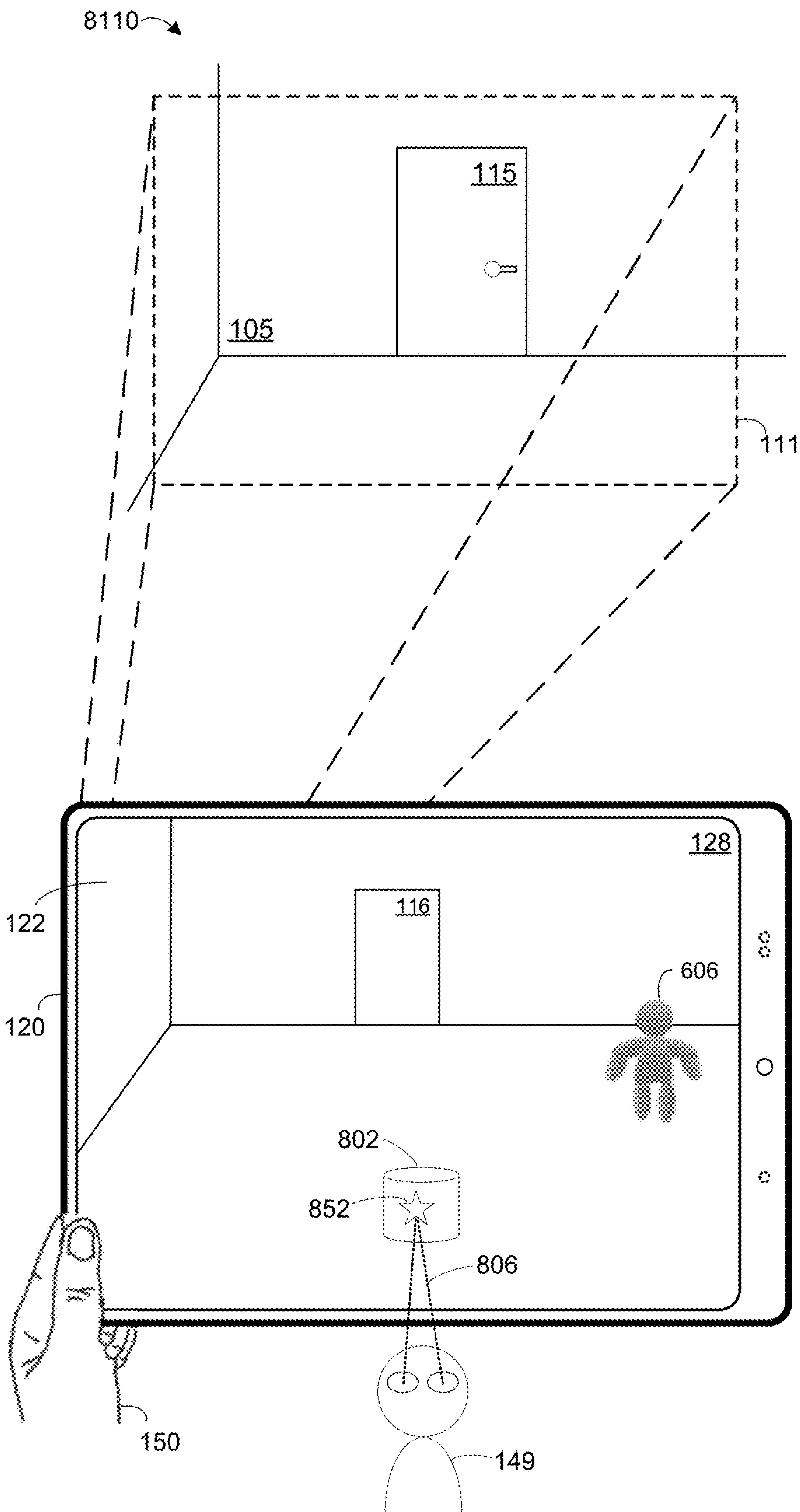

Figure 8K

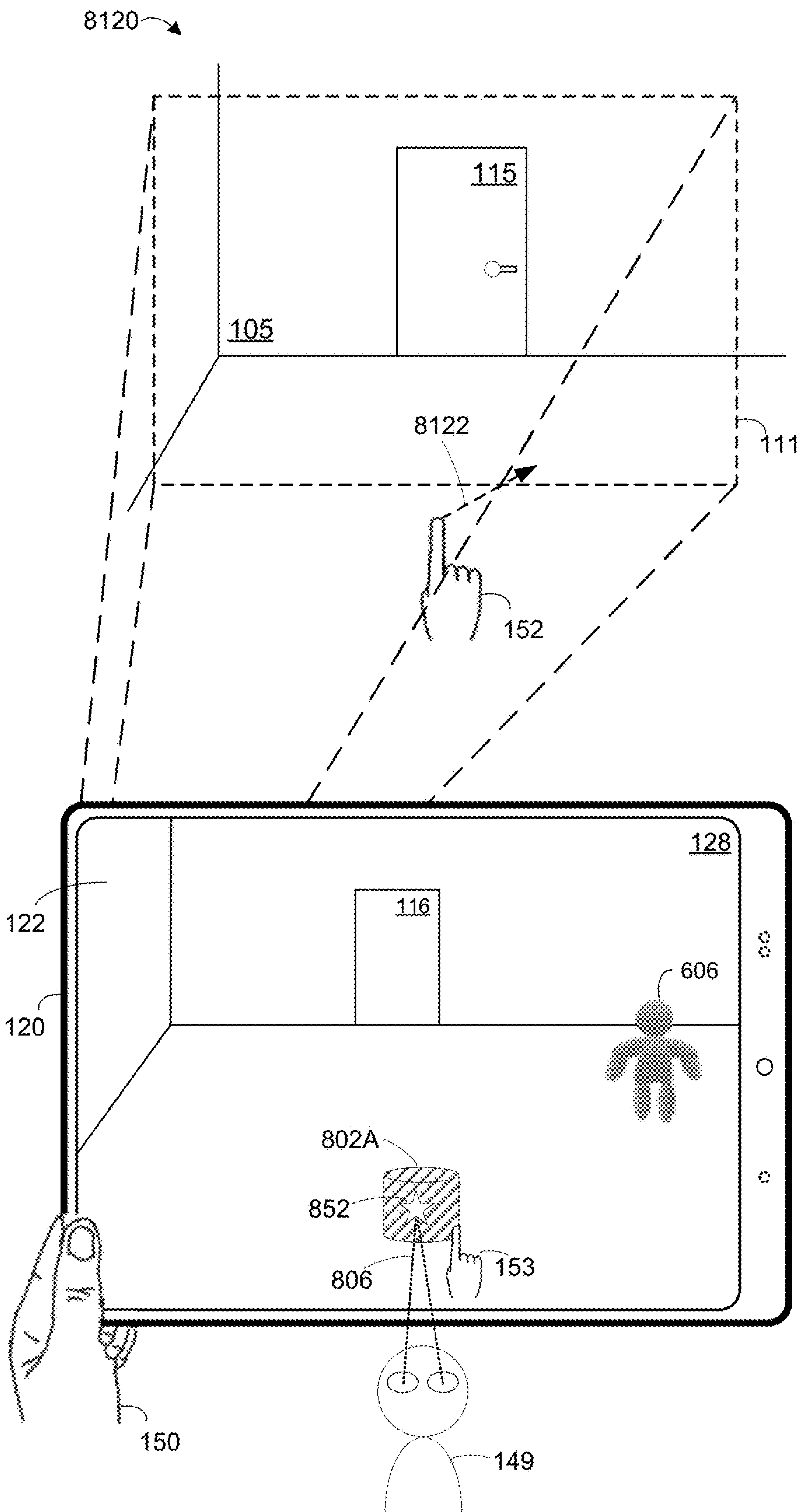
8120
115
105
8122
111
152
128
116
122
606
120
802A
852
153
806
150
149

Figure 8L

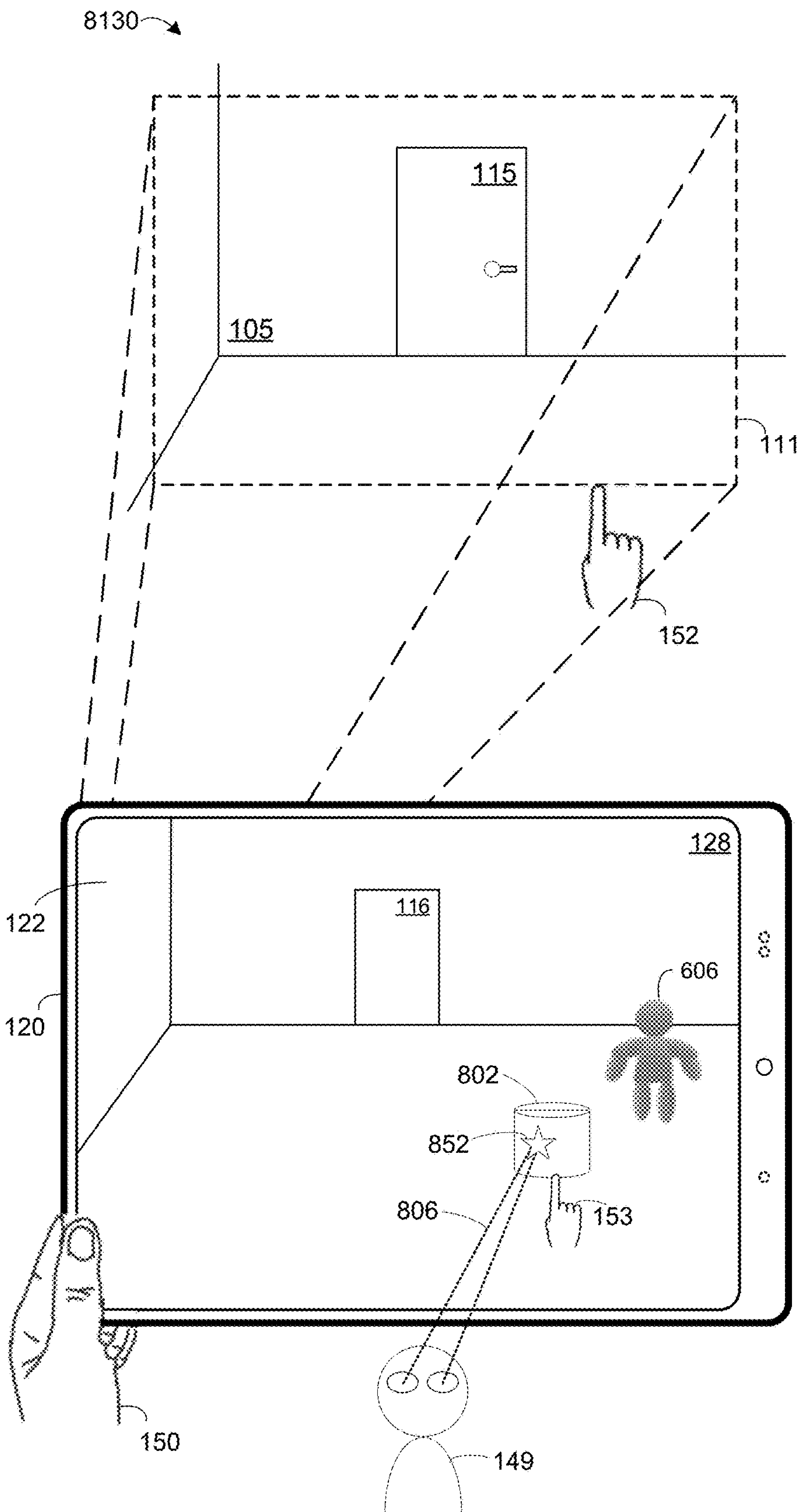

Figure 8M

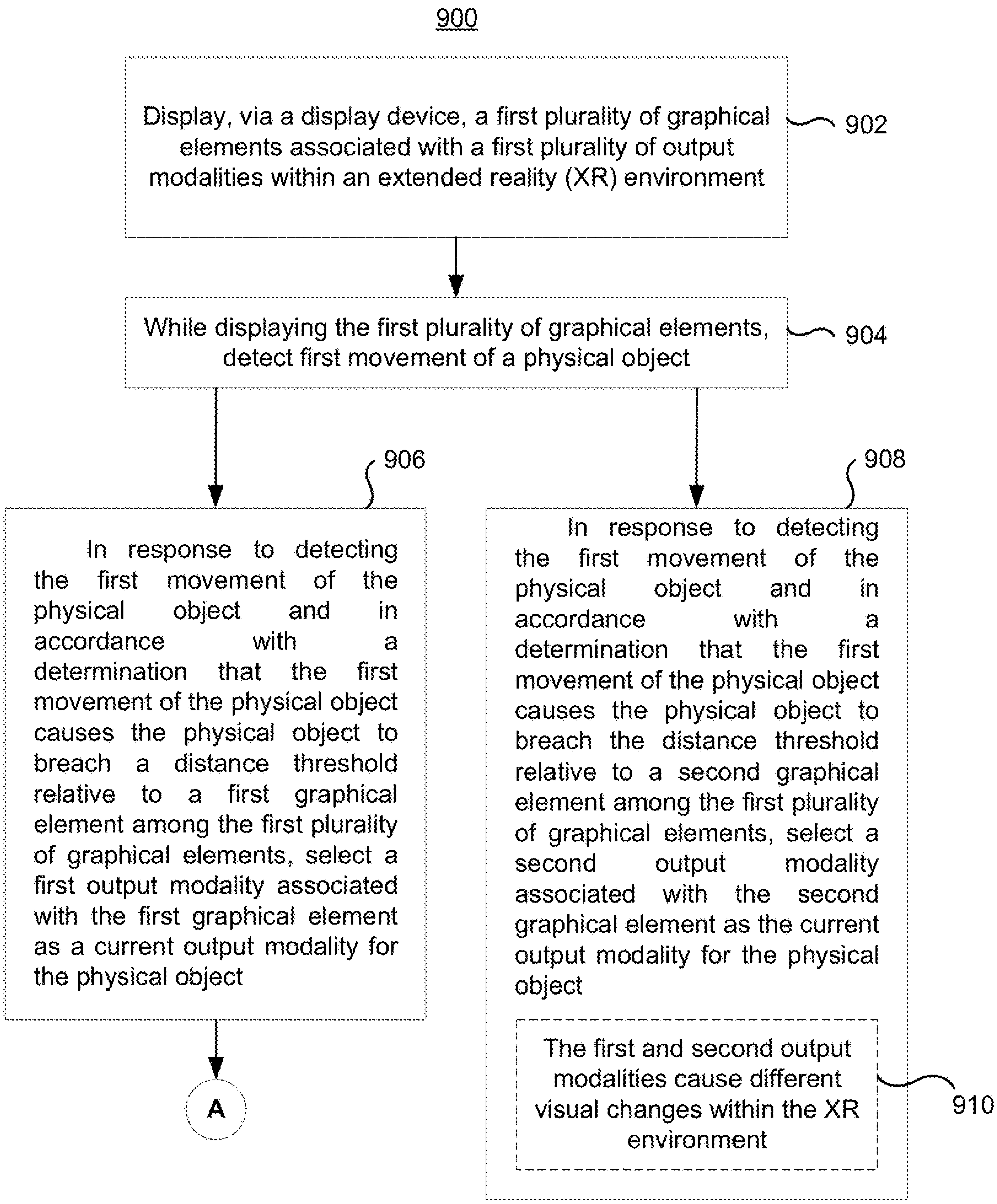
900
Display, via a display device, a first plurality of graphical elements associated with a first plurality of output modalities within an extended reality (XR) environment
902
While displaying the first plurality of graphical elements, detect first movement of a physical object
904
906
In response to detecting the first movement of the physical object and in accordance with a determination that the first movement of the physical object causes the physical object to breach a distance threshold relative to a first graphical element among the first plurality of graphical elements, select a first output modality associated with the first graphical element as a current output modality for the physical object
A
908
In response to detecting the first movement of the physical object and in accordance with a determination that the first movement of the physical object causes the physical object to breach the distance threshold relative to a second graphical element among the first plurality of graphical elements, select a second output modality associated with the second graphical element as the current output modality for the physical object
The first and second output modalities cause different visual changes within the XR environment
910

Figure 9A

A

After selecting the first output modality associated with the first graphical element as the current output modality for the physical object, detect a subsequent marking input with the physical object; and

In response to detecting the subsequent marking input, display, via the display device, one or more marks within the XR environment based on the subsequent marking input and the first output modality

912

B

In response to detecting the subsequent marking input:

In accordance with a determination that an input associated with how hard the physical object is being pressed against a physical surface corresponds to a first input value, display, via the display device, one or more marks with a first appearance within the XR environment based on the subsequent marking input and the first output modality, wherein the first appearance is associated with a parameter of the one or more marks that corresponds to the first input value; and

il accordance with a determination that the input associated with how hard the physical object is being pressed against a physical surface corresponds to a second input value, display, via the display device, one or more marks with a second appearance within the XR environment based on the subsequent marking input and the first output modality, wherein the second appearance is associated with the parameter of the one or more marks that corresponds to the second input value

914

The parameter corresponds to one of a radius, width, thickness, intensity, translucency, opacity, color, or texture of the mark within the XR environment

916

Figure 9B

B

In response to detecting the subsequent marking input:

In accordance with a determination that an input associated with how hard the physical object is being grasped by the user corresponds to a first input value, display, via the display device, one or more marks with a first appearance within the XR environment based on the subsequent marking input and the first output modality, wherein the first appearance is associated with a parameter of the one or more marks that corresponds to the first input value; and

In accordance with a determination that the input associated with how hard the physical object is being grasped by the user corresponds to a second input value, display, via the display device, one or more marks with a second appearance within the XR environment based on the subsequent marking input and the first output modality, wherein the second appearance is associated with the parameter of the one or more marks that corresponds to the second input value

918

The parameter corresponds to one of a radius, width, thickness, intensity, translucency, opacity, color, or texture of the mark within the XR environment

920

Figure 9C

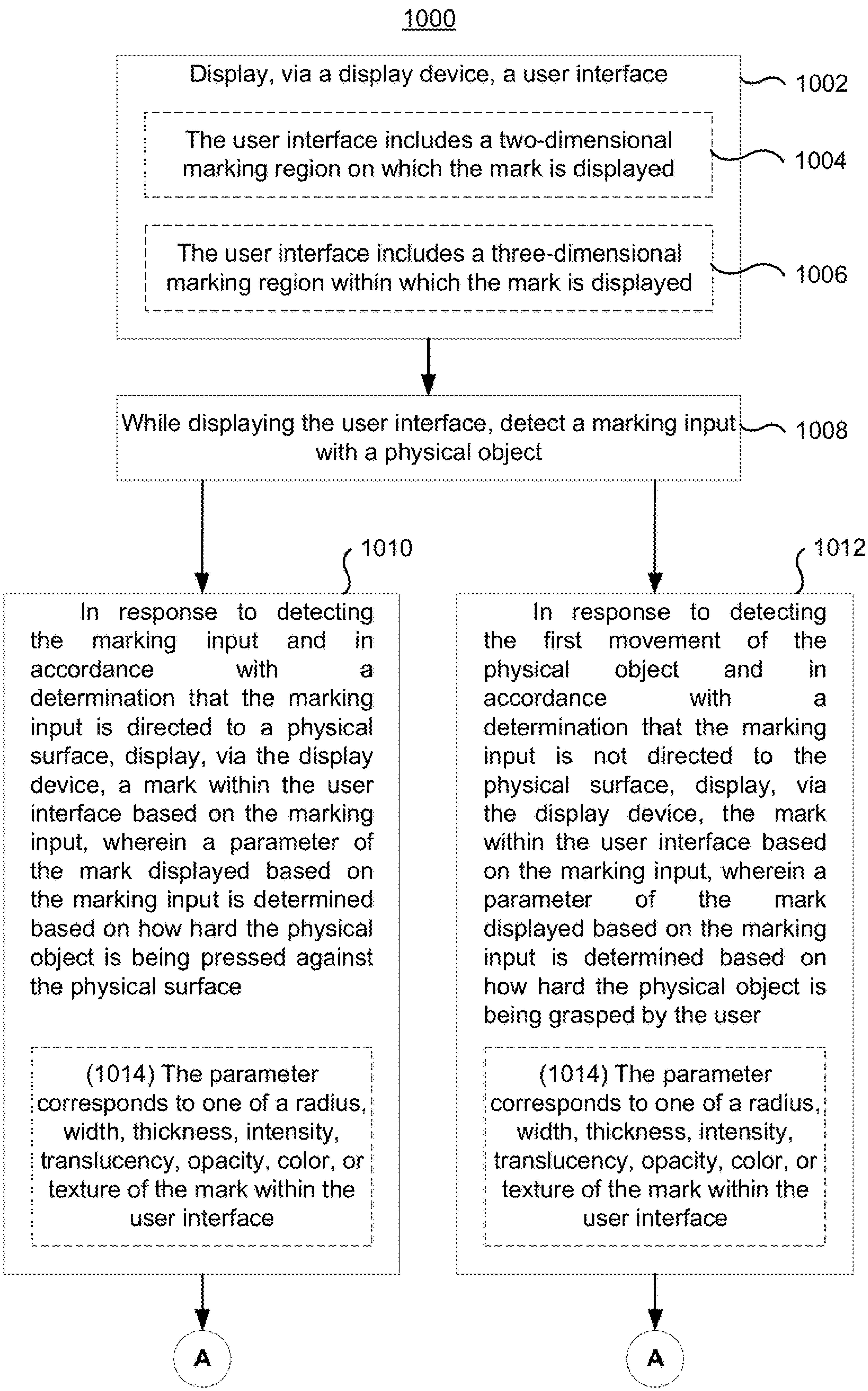
1000
Display, via a display device, a user interface
1002
The user interface includes a two-dimensional marking region on which the mark is displayed
1004
The user interface includes a three-dimensional marking region within which the mark is displayed
1006
While displaying the user interface, detect a marking input with a physical object
1008
1010
In response to detecting the marking input and in accordance with a determination that the marking input is directed to a physical surface, display, via the display device, a mark within the user interface based on the marking input, wherein a parameter of the mark displayed based on the marking input is determined based on how hard the physical object is being pressed against the physical surface
(1014) The parameter corresponds to one of a radius, width, thickness, intensity, translucency, opacity, color, or texture of the mark within the user interface
1012
In response to detecting the first movement of the physical object and in accordance with a determination that the marking input is not directed to the physical surface, display, via the display device, the mark within the user interface based on the marking input, wherein a parameter of the mark displayed based on the marking input is determined based on how hard the physical object is being grasped by the user
(1014) The parameter corresponds to one of a radius, width, thickness, intensity, translucency, opacity, color, or texture of the mark within the user interface
A
A

Figure 10A

A

After displaying the mark within the user interface, detect a subsequent input with the physical object associated with moving the mark within the user interface; and

In response to detecting the subsequent input, move the mark within the user interface based on the subsequent input

1016

Detecting the subsequent input corresponds to: obtaining an indication that a button on the physical object has been actuated; and detecting at least one of rotational or translational movement of the physical object

1018

Detecting the subsequent input corresponds to: obtaining an indication that an input value associated with how hard the physical object is being grasped by the user exceeds a threshold input value; and detecting at least one of rotational or translational movement of the physical object

1020

In response to detecting the subsequent input, change an appearance of at least some content within the user interface while moving the mark within the user interface

1022

A

In response to detecting the marking input and in accordance with a determination that the marking input is directed to the physical surface, display, via the display device, a simulated shadow within the XR environment that corresponds to a distance between the physical surface and the physical object

1024

Figure 10B

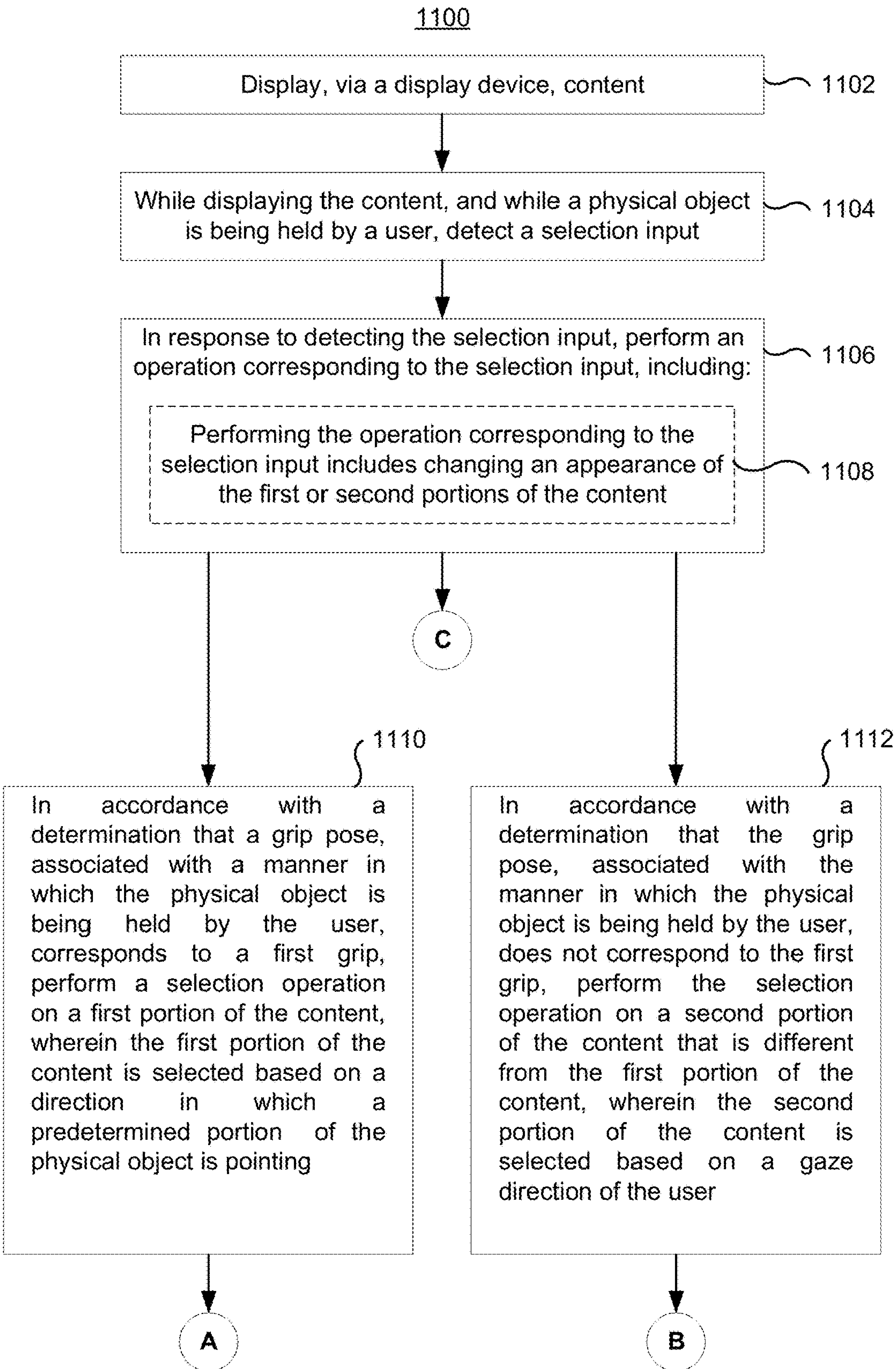
1100
Display, via a display device, content
1102
While displaying the content, and while a physical object is being held by a user, detect a selection input
1104
In response to detecting the selection input, perform an operation corresponding to the selection input, including:
1106
Performing the operation corresponding to the selection input includes changing an appearance of the first or second portions of the content
1108
C
1110
In accordance with a determination that a grip pose, associated with a manner in which the physical object is being held by the user, corresponds to a first grip, perform a selection operation on a first portion of the content, wherein the first portion of the content is selected based on a direction in which a predetermined portion of the physical object is pointing
1112
In accordance with a determination that the grip pose, associated with the manner in which the physical object is being held by the user, does not correspond to the first grip, perform the selection operation on a second portion of the content that is different from the first portion of the content, wherein the second portion of the content is selected based on a gaze direction of the user
A
B

Figure 11A

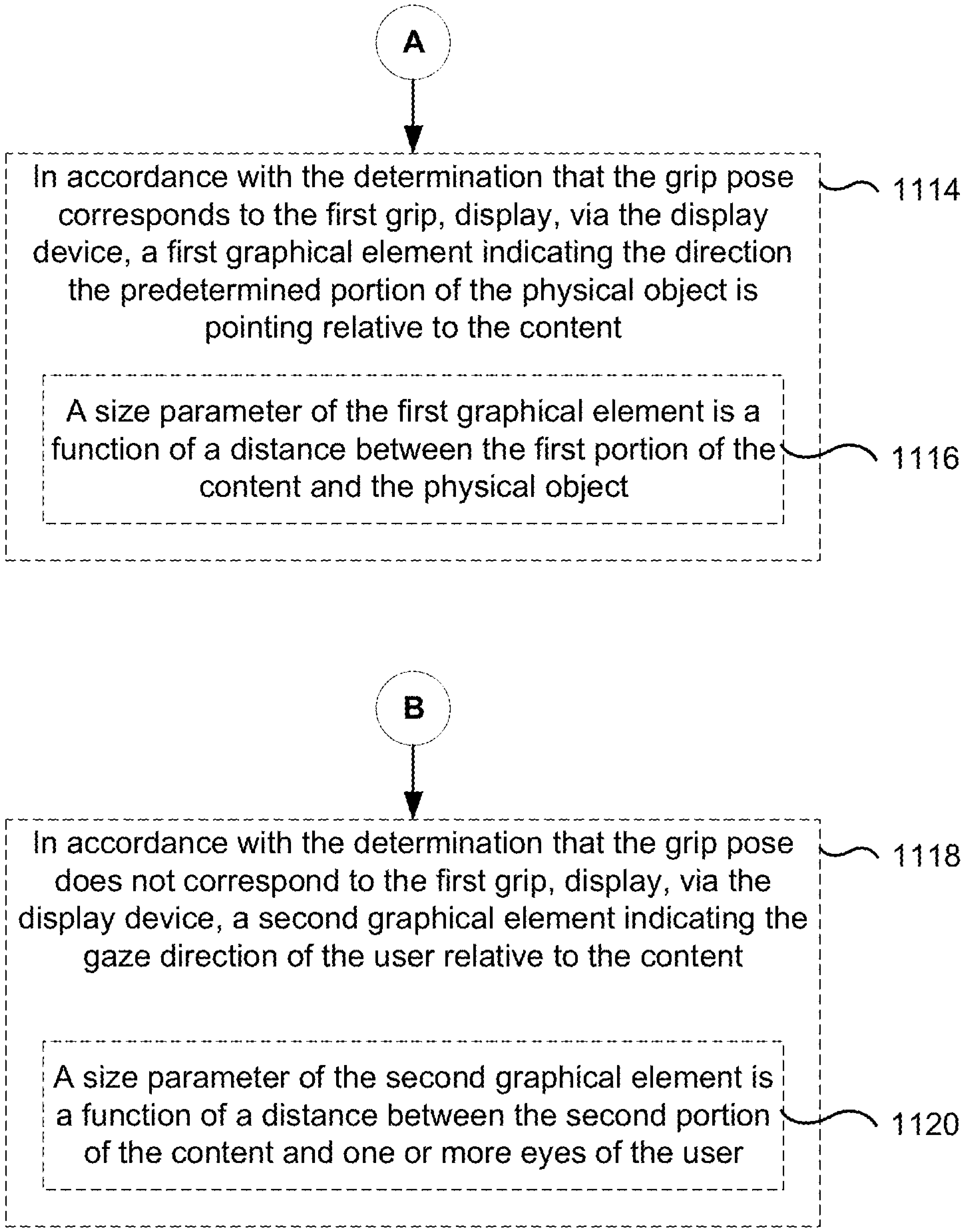
A
In accordance with the determination that the grip pose corresponds to the first grip, display, via the display device, a first graphical element indicating the direction the predetermined portion of the physical object is pointing relative to the content
1114
A size parameter of the first graphical element is a function of a distance between the first portion of the content and the physical object
1116
B
In accordance with the determination that the grip pose does not correspond to the first grip, display, via the display device, a second graphical element indicating the gaze direction of the user relative to the content
1118
A size parameter of the second graphical element is a function of a distance between the second portion of the content and one or more eyes of the user
1120

Figure 11B

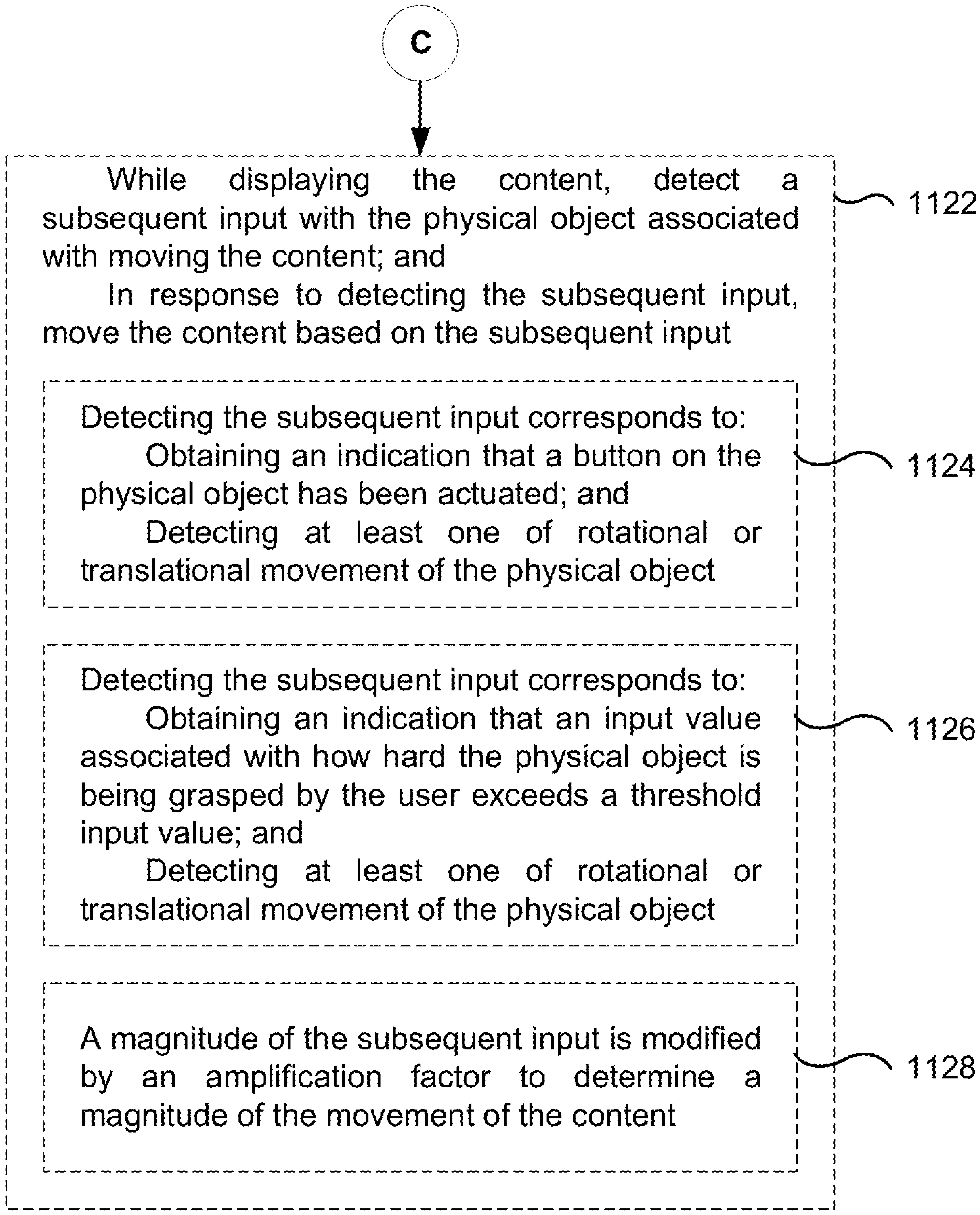
C
While displaying the content, detect a subsequent input with the physical object associated with moving the content; and
In response to detecting the subsequent input, move the content based on the subsequent input
1122
Detecting the subsequent input corresponds to:
Obtaining an indication that a button on the physical object has been actuated; and
Detecting at least one of rotational or translational movement of the physical object
1124
Detecting the subsequent input corresponds to:
Obtaining an indication that an input value associated with how hard the physical object is being grasped by the user exceeds a threshold input value; and
Detecting at least one of rotational or translational movement of the physical object
1126
A magnitude of the subsequent input is modified by an amplification factor to determine a magnitude of the movement of the content
1128

Figure 11C

METHOD AND DEVICE FOR MANAGING INTERACTIONS DIRECTED TO A USER INTERFACE WITH A PHYSICAL OBJECT

CROSS-REFERNCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent App. No. 63/226,070, filed on Jul. 27, 2021, which is incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present disclosure generally relates to interacting with and manipulating a user interface and, in particular, to systems, methods, and methods for managing interactions directed to the user interface with a physical object.

BACKGROUND

[0003] Typically, a user may interact with a user interface by way of various input modalities such as touch inputs, voice, inputs, stylus/peripheral inputs, or the like. However, a workflow for performing an operation within a user interface may remain the same regardless of the input modality. This overlooks opportunities for accelerating a user experience based on input modality or the like.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] So that the present disclosure can be understood by those of ordinary skill in the art, a more detailed description may be had by reference to aspects of some illustrative implementations, some of which are shown in the accompanying drawings.

[0005] FIG. **1** is a block diagram of an example operating architecture in accordance with some implementations.

[0006] FIG. **2** is a block diagram of an example controller in accordance with some implementations.

[0007] FIG. **3** is a block diagram of an example electronic device in accordance with some implementations.

[0008] FIG. **4** is a block diagram of an example control device in accordance with some implementations.

[0009] FIG. **5**A is a block diagram of a first portion of an example content delivery architecture in accordance with some implementations.

[0010] FIG. **5**B illustrates example data structures in accordance with some implementations.

[0011] FIG. **5**C is a block diagram of a second portion of the example content delivery architecture in accordance with some implementations.

[0012] FIGS. **6**A-**6**P illustrate a sequence of instances for a first content delivery scenario in accordance with some implementations.

[0013] FIGS. **7**A-**7**N illustrate a sequence of instances for a second content delivery scenario in accordance with some implementations.

[0014] FIGS. **8**A-**8**M illustrate a sequence of instances for a third content delivery scenario in accordance with some implementations.

[0015] FIGS. **9**A-**9**C illustrate a flowchart representation of a method of selecting an output modality for a physical object when interacting with or manipulating an XR environment in accordance with some implementations.

[0016] FIGS. **10**A and **10**B illustrate a flowchart representation of a method of changing a parameter of a mark based on a first input (pressure) value while marking directly on a physical surface or based on a second input (pressure) value while marking indirectly in accordance with some implementations.

[0017] FIGS. **11**A-**11**C illustrate a flowchart representation of a method of changing a selection modality based on whether a user is currently grasping a physical object in accordance with some implementations.

[0018] In accordance with common practice the various features illustrated in the drawings may not be drawn to scale. Accordingly, the dimensions of the various features may be arbitrarily expanded or reduced for clarity. In addition, some of the drawings may not depict all of the components of a given system, method, or device. Finally, like reference numerals may be used to denote like features throughout the specification and figures.

SUMMARY

[0019] Various implementations disclosed herein include devices, systems, and methods for selecting an output modality for a physical object when interacting with or manipulating an XR environment. According to some implementations, the method is performed at a computing system including non-transitory memory and one or more processors, wherein the computing system is communicatively coupled to a display device and one or more input devices. The method includes: displaying, via the display device, a first plurality of graphical elements associated with a first plurality of output modalities within an extended reality (XR) environment; while displaying the first plurality of graphical elements, detecting first movement of a physical object; and in response to detecting the first movement of the physical object: in accordance with a determination that the first movement of the physical object causes the physical object to breach a distance threshold relative to a first graphical element among the first plurality of graphical elements, selecting a first output modality associated with the first graphical element as a current output modality for the physical object; and in accordance with a determination that the first movement of the physical object causes the physical to breach the distance threshold relative to a second graphical element among the first plurality of graphical elements, selecting a second output modality associated with the second graphical element as the current output modality for the physical object.

[0020] Various implementations disclosed herein include devices, systems, and methods for changing a parameter of a mark based on a first input (pressure) value while marking directly on a physical surface or based on a second input (pressure) value while marking indirectly. According to some implementations, the method is performed at a computing system including non-transitory memory and one or more processors, wherein the computing system is communicatively coupled to a display device and one or more input devices. The method includes: displaying, via the display device, a user interface; while displaying the user interface, detecting a marking input with a physical object; and in response to detecting the marking input: in accordance with a determination that the marking input is directed to a physical surface, displaying, via the display device, a mark within the user interface based on the marking input, wherein a parameter of the mark displayed based on the marking input is determined based on how hard the physical object is being pressed against the physical surface; and in accordance with a determination that the marking input is not directed to the physical surface, displaying, via the display device, the mark within the user interface based on the marking input, wherein a parameter of the mark displayed based on the marking input is determined based on how hard the physical object is being grasped by the user.

[0021] Various implementations disclosed herein include devices, systems, and methods for changing a selection modality based on whether a user is currently grasping a physical object. According to some implementations, the method is performed at a computing system including non-transitory memory and one or more processors, wherein the computing system is communicatively coupled to a display device and one or more input devices. The method includes: displaying, via the display device, content; while displaying the content, and while a physical object is being held by a user, detecting a selection input; and in response to detecting the selection input, performing an operation corresponding to the selection input, including; in accordance with a determination that a grip pose, associated with a manner in which the physical object is being held by the user, corresponds to a first grip, performing a selection operation on a first portion of the content, wherein the first portion of the content is selected based on a direction in which a predetermined portion of the physical object is pointing; and in accordance with a determination that the grip pose, associated with the manner in which the physical object is being held by the user, does not correspond to the first grip, performing the selection operation on a second portion of the content that is different from the first portion of the content, wherein the second portion of the content is selected based on a gaze direction of the user.

[0022] In accordance with some implementations, an electronic device includes one or more displays, one or more processors, a non-transitory memory, and one or more programs; the one or more programs are stored in the non-transitory memory and configured to be executed by the one or more processors and the one or more programs include instructions for performing or causing performance of any of the methods described herein. In accordance with some implementations, a non-transitory computer readable storage medium has stored therein instructions, which, when executed by one or more processors of a device, cause the device to perform or cause performance of any of the methods described herein. In accordance with some implementations, a device includes: one or more displays, one or more processors, a non-transitory memory, and means for performing or causing performance of any of the methods described herein.

[0023] In accordance with some implementations, a computing system includes one or more processors, non-transitory memory, an interface for communicating with a display device and one or more input devices, and one or more programs; the one or more programs are stored in the non-transitory memory and configured to be executed by the one or more processors and the one or more programs include instructions for performing or causing performance of the operations of any of the methods described herein. In accordance with some implementations, a non-transitory computer readable storage medium has stored therein instructions which when executed by one or more processors of a computing system with an interface for communicating with a display device and one or more input devices, cause the computing system to perform or cause performance of the operations of any of the methods described herein. In accordance with some implementations, a computing system includes one or more processors, non-transitory memory, an interface for communicating with a display device and one or more input devices, and means for performing or causing performance of the operations of any of the methods described herein.

DESCRIPTION

[0024] Numerous details are described in order to provide a thorough understanding of the example implementations shown in the drawings. However, the drawings merely show some example aspects of the present disclosure and are therefore not to be considered limiting. Those of ordinary skill in the art will appreciate that other effective aspects and/or variants do not include all of the specific details described herein. Moreover, well-known systems, methods, components, devices, and circuits have not been described in exhaustive detail so as not to obscure more pertinent aspects of the example implementations described herein.

[0025] A physical environment refers to a physical world that people can sense and/or interact with without aid of electronic devices. The physical environment may include physical features such as a physical surface or a physical object. For example, the physical environment corresponds to a physical park that includes physical trees, physical buildings, and physical people. People can directly sense and/or interact with the physical environment such as through sight, touch, hearing, taste, and smell. In contrast, an extended reality (XR) environment refers to a wholly or partially simulated environment that people sense and/or interact with via an electronic device. For example, the XR environment may include augmented reality (AR) content, mixed reality (MR) content, virtual reality (VR) content, and/or the like. With an XR system, a subset of a person's physical motions, or representations thereof, are tracked, and, in response, one or more characteristics of one or more virtual objects simulated in the XR environment are adjusted in a manner that comports with at least one law of physics. As one example, the XR system may detect head movement and, in response, adjust graphical content and an acoustic field presented to the person in a manner similar to how such views and sounds would change in a physical environment. As another example, the XR system may detect movement of the electronic device presenting the XR environment (e.g., a mobile phone, a tablet, a laptop, or the like) and, in response, adjust graphical content and an acoustic field presented to the person in a manner similar to how such views and sounds would change in a physical environment. In some situations (e.g., for accessibility reasons), the XR system may adjust characteristic(s) of graphical content in the XR environment in response to representations of physical motions (e.g., vocal commands).

[0026] There are many different types of electronic systems that enable a person to sense and/or interact with various XR environments. Examples include head mountable systems, projection-based systems, heads-up displays (HUDs), vehicle windshields having integrated display capability, windows having integrated display capability, displays formed as lenses designed to be placed on a person's eyes (e.g., similar to contact lenses), headphones/earphones, speaker arrays, input systems (e.g., wearable or handheld controllers with or without haptic feedback), smartphones, tablets, and desktop/laptop computers. A head mountable system may have one or more speaker(s) and an integrated opaque display. Alternatively, ahead mountable system may be configured to accept an external opaque display (e.g., a smartphone). The head mountable system may incorporate one or more imaging sensors to capture images or video of the physical environment, and/or one or more microphones to capture audio of the physical environment. Rather than an opaque display, a head mountable system may have a transparent or translucent display. The transparent or translucent display may have a medium through which light representative of images is directed to a person's eyes. The display may utilize digital light projection, OLEDs, LEDs, μLEDs, liquid crystal on silicon, laser scanning light source, or any combination of these technologies. The medium may be an optical waveguide, a hologram medium, an optical combiner, an optical reflector, or any combination thereof. In some implementations, the transparent or translucent display may be configured to become opaque selectively. Projection-based systems may employ retinal projection technology that projects graphical images onto a person's retina. Projection systems also may be configured to project virtual objects into the physical environment, for example, as a hologram or on a physical surface.

[0027] FIG. **1** is a block diagram of an example operating architecture **100** in accordance with some implementations. While pertinent features are shown, those of ordinary skill in the art will appreciate from the present disclosure that various other features have not been illustrated for the sake of brevity and so as not to obscure more pertinent aspects of the example implementations disclosed herein. To that end, as a non-limiting example, the operating architecture **100** includes an optional controller **110** and an electronic device **120** (e.g., a tablet, mobile phone, laptop, near-eye system, wearable computing device, or the like).

[0028] In some implementations, the controller **110** is configured to manage and coordinate an XR experience (sometimes also referred to herein as a "XR environment" or a "virtual environment" or a "graphical environment") for a user **149** with a left hand **150** and a right hand **152** and optionally other users. In some implementations, the controller **110** includes a suitable combination of software, firmware, and/or hardware. The controller **110** is described in greater detail below with respect to FIG. **2**. In some implementations, the controller **110** is a computing device that is local or remote relative to the physical environment **105**. For example, the controller **110** is a local server located within the physical environment **105**. In another example, the controller **110** is a remote server located outside of the physical environment **105** (e.g., a cloud server, central server, etc.). In some implementations, the controller **110** is communicatively coupled with the electronic device **120** via one or more wired or wireless communication channels **144** (e.g., BLUETOOTH, IEEE 802.11x, IEEE 802.16x, IEEE 802.3x, etc.). In some implementations, the functions of the controller **110** are provided by the electronic device **120**. As such, in some implementations, the components of the controller **110** are integrated into the electronic device **120**.

[0029] As shown in FIG. **1**, the user **149** grasps a control device **130** in his/her right hand **152**. As shown in FIG. **1**, the control device **130** includes a first end **176** and a second end **177**. In various embodiments, the first end **176** corresponds to a tip of the control device **130** (e.g., the tip of a pencil) and the second end **177** corresponds to the opposite or bottom end of the control device **130** (e.g., the eraser of the pencil). As shown in FIG. **1**, the control device **130** includes a touch-sensitive surface **175** to receive touch inputs from the user **149**. In some implementations, the control device **130** includes a suitable combination of software, firmware, and/or hardware. The control device **130** is described in greater detail below with respect to FIG. **4**. In some implementations, the control device **130** corresponds to an electronic device with a wired or wireless communication channel to the controller **110**. For example, the control device **130** corresponds to a stylus, a finger-wearable device, a handheld device, or the like. In some implementations, the controller **110** is communicatively coupled with the control device **130** via one or more wired or wireless communication channels **146** (e.g., BLUETOOTH, IEEE 802.11x, IEEE 802.16x, IEEE 802.3x, etc.).

[0030] In some implementations, the electronic device **120** is configured to present audio and/or video (A/V) content to the user **149**. In some implementations, the electronic device **120** is configured to present a user interface (UI) and/or an XR environment **128** to the user **149**. In some implementations, the electronic device **120** includes a suitable combination of software, firmware, and/or hardware. The electronic device **120** is described in greater detail below with respect to FIG. **3**.

[0031] According to some implementations, the electronic device **120** presents an XR experience to the user **149** while the user **149** is physically present within a physical environment **105** that includes a table **107** within the field-of-view (FOV) **111** of the electronic device **120**. As such, in some implementations, the user **149** holds the electronic device **120** in his/her hand(s). In some implementations, while presenting the XR experience, the electronic device **120** is configured to present XR content (sometimes also referred to herein as "graphical content" or "virtual content"), including an XR cylinder **109**, and to enable video pass-through of the physical environment **105** (e.g., including the table **107** or a representation thereof) on a display **122**. For example, the XR environment **128**, including the XR cylinder **109**, is volumetric or three-dimensional (3D).

[0032] In one example, the XR cylinder **109** corresponds to display-locked content such that the XR cylinder **109** remains displayed at the same location on the display **122** as the FOV **111** changes due to translational and/or rotational movement of the electronic device **120**. As another example, the XR cylinder **109** corresponds to world-locked content such that the XR cylinder **109** remains displayed at its origin location as the FOV **111** changes due to translational and/or rotational movement of the electronic device **120**. As such, in this example, if the FOV **111** does not include the origin location, the XR environment **128** will not include the XR cylinder **109**. For example, the electronic device **120** corresponds to a near-eye system, mobile phone, tablet, laptop, wearable computing device, or the like.

[0033] In some implementations, the display **122** corresponds to an additive display that enables optical see-through of the physical environment **105** including the table **107**. For example, the display **122** corresponds to a transparent lens, and the electronic device **120** corresponds to a pair of glasses worn by the user **149**. As such, in some implementations, the electronic device **120** presents a user interface by projecting the XR content (e.g., the XR cylinder **109**) onto the additive display, which is, in turn, overlaid on the physical environment **105** from the perspective of the user **149**. In some implementations, the electronic device **120** presents the user interface by displaying the XR content (e.g., the XR cylinder **109**) on the additive display, which is, in turn, overlaid on the physical environment **105** from the perspective of the user **149**.

[0034] In some implementations, the user **149** wears the electronic device **120** such as a near-eye system. As such, the electronic device **120** includes one or more displays provided to display the XR content (e.g., a single display or one for each eye). For example, the electronic device **120** encloses the FOV of the user **149**. In such implementations, the electronic device **120** presents the XR environment **128** by displaying data corresponding to the XR environment **128** on the one or more displays or by projecting data corresponding to the XR environment **128** onto the retinas of the user **149**.

[0035] In some implementations, the electronic device **120** includes an integrated display (e.g., a built-in display) that displays the XR environment **128**. In some implementations, the electronic device **120** includes a head-mountable enclosure. In various implementations, the head-mountable enclosure includes an attachment region to which another device with a display can be attached. For example, in some implementations, the electronic device **120** can be attached to the head-mountable enclosure. In various implementations, the head-mountable enclosure is shaped to form a receptacle for receiving another device that includes a display (e.g., the electronic device **120**). For example, in some implementations, the electronic device **120** slides/snaps into or otherwise attaches to the head-mountable enclosure. In some implementations, the display of the device attached to the head-mountable enclosure presents (e.g., displays) the XR environment **128**. In some implementations, the electronic device **120** is replaced with an XR chamber, enclosure, or room configured to present XR content in which the user **149** does not wear the electronic device **120**.

[0036] In some implementations, the controller **110** and/or the electronic device **120** cause an XR representation of the user **149** to move within the XR environment **128** based on movement information (e.g., body pose data, eye tracking data, hand/limb/finger/extremity tracking data, etc.) from the electronic device **120** and/or optional remote input devices within the physical environment **105**. In some implementations, the optional remote input devices correspond to fixed or movable sensory equipment within the physical environment **105** (e.g., image sensors, depth sensors, infrared (IR) sensors, event cameras, microphones, etc.). In some implementations, each of the remote input devices is configured to collect/capture input data and provide the input data to the controller **110** and/or the electronic device **120** while the user **149** is physically within the physical environment **105**. In some implementations, the remote input devices include microphones, and the input data includes audio data associated with the user **149** (e.g., speech samples). In some implementations, the remote input devices include image sensors (e.g., cameras), and the input data includes images of the user **149**. In some implementations, the input data characterizes body poses of the user **149** at different times. In some implementations, the input data characterizes head poses of the user **149** at different times. In some implementations, the input data characterizes hand tracking information associated with the hands of the user **149** at different times. In some implementations, the input data characterizes the velocity and/or acceleration of body parts of the user **149** such as his/her hands. In some implementations, the input data indicates joint positions and/or joint orientations of the user **149**. In some implementations, the remote input devices include feedback devices such as speakers, lights, or the like.

[0037] FIG. **2** is a block diagram of an example of the controller **110** in accordance with some implementations. While certain specific features are illustrated, those skilled in the art will appreciate from the present disclosure that various other features have not been illustrated for the sake of brevity, and so as not to obscure more pertinent aspects of the implementations disclosed herein. To that end, as a non-limiting example, in some implementations, the controller **110** includes one or more processing units **202** (e.g., microprocessors, application-specific integrated-circuits (ASICs), field-programmable gate arrays (FPGAs), graphics processing units (GPUs), central processing units (CPUs), processing cores, and/or the like), one or more input/output (I/O) devices **206**, one or more communication interfaces **208** (e.g., universal serial bus (USB), IEEE 802.3x, IEEE 802.11x, IEEE 802.16x, global system for mobile communications (GSM), code division multiple access (CDMA), time division multiple access (TDMA), global positioning system (GPS), infrared (IR), BLUETOOTH, ZIGBEE, and/or the like type interface), one or more programming (e.g., I/O) interfaces **210**, a memory **220**, and one or more communication buses **204** for interconnecting these and various other components.

[0038] In some implementations, the one or more communication buses **204** include circuitry that interconnects and controls communications between system components. In some implementations, the one or more I/O devices **206** include at least one of a keyboard, a mouse, a touchpad, a touchscreen, a joystick, one or more microphones, one or more speakers, one or more image sensors, one or more displays, and/or the like.

[0039] The memory **220** includes high-speed random-access memory, such as dynamic random-access memory (DRAM), static random-access memory (SRAM), double-data-rate random-access memory (DDR RAM), or other random-access solid-state memory devices. In some implementations, the memory **220** includes non-volatile memory, such as one or more magnetic disk storage devices, optical disk storage devices, flash memory devices, or other non-volatile solid-state storage devices. The memory **220** optionally includes one or more storage devices remotely located from the one or more processing units **202**. The memory **220** comprises a non-transitory computer readable storage medium. In some implementations, the memory **220** or the non-transitory computer readable storage medium of the memory **220** stores the following programs, modules and data structures, or a subset thereof described below with respect to FIG. **2**.

[0040] The operating system **230** includes procedures for handling various basic system services and for performing hardware dependent tasks.

[0041] In some implementations, a data obtainer **242** is configured to obtain data (e.g., captured image frames of the physical environment **105**, presentation data, input data, user interaction data, camera pose tracking information, eye tracking information, head/body pose tracking information, hand/limb/finger/extremity tracking information, sensor data, location data, etc.) from at least one of the I/O devices **206** of the controller **110**, the I/O devices and sensors **306** of the electronic device **120**, and the optional remote input devices. To that end, in various implementations, the data obtainer **242** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0042] In some implementations, a mapper and locator engine **244** is configured to map the physical environment **105** and to track the position/location of at least the electronic device **120** or the user **149** with respect to the physical environment **105**. To that end, in various implementations, the mapper and locator engine **244** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0043] In some implementations, a data transmitter **246** is configured to transmit data (e.g., presentation data such as rendered image frames associated with the XR environment, location data, etc.) to at least the electronic device **120** and optionally one or more other devices. To that end, in various implementations, the data transmitter **246** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0044] In some implementations, a privacy architecture **508** is configured to ingest data and filter user information and/or identifying information within the data based on one or more privacy filters. The privacy architecture **508** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the privacy architecture **508** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0045] In some implementations, an object tracking engine **510** is configured to determine/generate an object tracking vector **511** for tracking a physical object (e.g., the control device **130** or a proxy object) based on tracking data and update the object tracking vector **511** over time. For example, as shown in FIG. **5**B, the object tracking vector **511** includes translational values **572** for the physical object (e.g., associated with x, y, and z coordinates relative to the physical environment **105** or the world-at-large), rotational values **574** for the physical object (e.g., roll, pitch, and yaw), one or more pressure values **576** associated with the physical object, optional touch input information **578** associated with the physical object, and/or the like. The object tracking engine **510** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the object tracking engine **510** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0046] In some implementations, an eye tracking engine **512** is configured to determine/generate an eye tracking vector **513** as shown in FIG. **5**B (e.g., with a gaze direction) based on the input data and update the eye tracking vector **513** over time. For example, the gaze direction indicates a point (e.g., associated with x, y, and z coordinates relative to the physical environment **105** or the world-at-large), a physical object, or a region of interest (ROI) in the physical environment **105** at which the user **149** is currently looking. As another example, the gaze direction indicates a point (e.g., associated with x, y, and z coordinates relative to the XR environment **128**), an XR object, or a region of interest (ROI) in the XR environment **128** at which the user **149** is currently looking. The eye tracking engine **512** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the eye tracking engine **512** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0047] In some implementations, a body/head pose tracking engine **514** is configured to determine/generate a pose characterization vector **515** based on the input data and update the pose characterization vector **515** over time. For example, as shown in FIG. **5**B, the pose characterization vector **515** includes a head pose descriptor **592**A (e.g., upward, downward, neutral, etc.), translational values **592**B for the head pose, rotational values **592**C for the head pose, a body pose descriptor **594**A (e.g., standing, sitting, prone, etc.), translational values **594**B for body sections/extremities/limbs/joints, rotational values **594**C for the body sections/extremities/limbs/joints, and/or the like. The body/head pose tracking engine **514** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the body/head pose tracking engine **514** includes instructions and/or logic therefor, and heuristics and metadata therefor. In some implementations, the object tracking engine **510**, the eye tracking engine **512**, and the body/head pose tracking engine **514** may be located on the electronic device **120** in addition to or in place of the controller **110**.

[0048] In some implementations, a content selector **542** is configured to select XR content (sometimes also referred to herein as "graphical content" or "virtual content") from a content library **545** based on one or more user requests and/or inputs (e.g., a voice command, a selection from a user interface (UI) menu of XR content items, and/or the like). The content selector **542** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the content selector **542** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0049] In some implementations, the content library **545** includes a plurality of content items such as audio/visual (A/V) content, virtual agents (VAs), and/or XR content, objects, items, scenery, etc. As one example, the XR content includes 3D reconstructions of user captured videos, movies, TV episodes, and/or other XR content. In some implementations, the content library **545** is pre-populated or manually authored by the user **149**. In some implementations, the content library **545** is located local relative to the controller **110**. In some implementations, the content library **545** is located remote from the controller **110** (e.g., at a remote server, a cloud server, or the like).

[0050] In some implementations, an input manager **520** is configured to ingest and analyze input data from various input sensors. The input manager **520** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the input manager **520** includes instructions and/or logic therefor, and heuristics and metadata therefor. In some implementations, the input manager **520** includes a data aggregator **521**, a content selection engine **522**, a grip pose evaluator **524**, an output modality selector **526**, and a parameter adjustor **528**.

[0051] In some implementations, the data aggregator **521** is configured to aggregate the object tracking vector **511**, the eye tracking vector **513**, and the pose characterization vector **515** and determine/generate a characterization vector **531** (as shown in FIG. **5**A) based thereon for subsequent downstream usage. The data aggregator **521** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the data aggregator **521** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0052] In some implementations, the content selection engine **522** is configured to determine a selected content portion **523** (as shown in FIG. **5**A) within the XR environment **128** based on the characterization vector **531** (or a portion thereof). The content selection engine **522** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the content selection engine **522** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0053] In some implementations, the grip pose evaluator **524** is configured to determine a grip pose **525** (as shown in FIG. **5**A) associated with a current manner in which the physical object is being held by the user **149** based on the characterization vector **531** (or a portion thereof). For example, the grip pose **525** indicates a manner in which the user **149** grasps the physical object (e.g., a proxy object, the control device **130**, or the like). For example, the grip pose **525** corresponds to one of a remote-control-esque grip, a pointing/wand-esque grip, a writing grip, an inverse writing grip, a handle grip, a thumb top grip, a level-esque grip, a gamepad-esque grip, a flute-esque grip, a fire-starter-esque grip, or the like. The grip pose evaluator **524** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the grip pose evaluator **524** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0054] In some implementations, the output modality selector **526** is configured to select a current output modality **527** (as shown in FIG. **5**A) associated with a manner in which the physical object interacts with the XR environment **128** or manipulates the XR environment **128**. For example, a first output modality corresponds to selecting/manipulating object(s)/content within the XR environment **128**, and a second output modality corresponds to sketching, drawing, writing, etc. within the XR environment **128**. The output modality selector **526** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the output modality selector **526** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0055] In some implementations, the parameter adjustor **528** is configured to adjust a parameter value (as shown in FIG. **5**A) (e.g., thickness, brightness, color, texture, etc.) associated with a marking input directed to the XR environment **128** based on either a first input (pressure) value or a second input (pressure) value associated with the physical object. The parameter adjustor **528** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the parameter adjustor **528** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0056] In some implementations, a content manager **530** is configured to manage and update the layout, setup, structure, and/or the like for the XR environment **128** including one or more of VA(s), XR content, one or more user interface (UI) elements associated with the XR content, and/or the like. The content manager **530** is described in more detail below with reference to FIG. **5**C. To that end, in various implementations, the content manager **530** includes instructions and/or logic therefor, and heuristics and metadata therefor. In some implementations, the content manager **530** includes a buffer **534**, a content updater **536**, and a feedback engine **538**. In some implementations, the buffer **534** includes XR content, a rendered image frame, and/or the like for one or more past instances and/or frames.

[0057] In some implementations, the content updater **536** is configured to modify the XR environment **128** over time based on translational or rotational movement of the electronic device **120** or physical objects within the physical environment **105**, user inputs (e.g., hand/extremity tracking inputs, eye tracking inputs, touch inputs, voice commands, manipulation inputs with the physical object, and/or the like), and/or the like. To that end, in various implementations, the content updater **536** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0058] In some implementations, the feedback engine **538** is configured to generate sensory feedback (e.g., visual feedback such as text or lighting changes, audio feedback, haptic feedback, etc.) associated with the XR environment **128**. To that end, in various implementations, the feedback engine **538** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0059] In some implementations, a rendering engine **550** is configured to render an XR environment **128** (sometimes also referred to herein as a "graphical environment" or "virtual environment") or image frame associated therewith as well as the VA(s), XR content, one or more UI elements associated with the XR content, and/or the like. To that end, in various implementations, the rendering engine **550** includes instructions and/or logic therefor, and heuristics and metadata therefor. In some implementations, the rendering engine **550** includes a pose determiner **552**, a renderer **554**, an optional image processing architecture **562**, and an optional compositor **564**. One of ordinary skill in the art will appreciate that the optional image processing architecture **562** and the optional compositor **564** may be present for video pass-through configurations but may be removed for fully VR or optical see-through configurations.

[0060] In some implementations, the pose determiner **552** is configured to determine a current camera pose of the electronic device **120** and/or the user **149** relative to the A/V content and/or XR content. The pose determiner **552** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the pose determiner **552** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0061] In some implementations, the renderer **554** is configured to render the A/V content and/or the XR content according to the current camera pose relative thereto. The renderer **554** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the renderer **554** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0062] In some implementations, the image processing architecture **562** is configured to obtain (e.g., receive, retrieve, or capture) an image stream including one or more images of the physical environment **105** from the current camera pose of the electronic device **120** and/or the user **149**. In some implementations, the image processing architecture **562** is also configured to perform one or more image processing operations on the image stream such as warping, color correction, gamma correction, sharpening, noise reduction, white balance, and/or the like. The image processing architecture **562** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the image processing architecture **562** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0063] In some implementations, the compositor **564** is configured to composite the rendered A/V content and/or XR content with the processed image stream of the physical environment **105** from the image processing architecture

562 to produce rendered image frames of the XR environment **128** for display. The compositor **564** is described in more detail below with reference to FIG. **5**A. To that end, in various implementations, the compositor **564** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0064] Although the data obtainer **242**, the mapper and locator engine **244**, the data transmitter **246**, the privacy architecture **508**, the object tracking engine **510**, the eye tracking engine **512**, the body/head pose tracking engine **514**, the content selector **542**, the content manager **530**, the operation modality manager **540**, and the rendering engine **550** are shown as residing on a single device (e.g., the controller **110**), it should be understood that in other implementations, any combination of the data obtainer **242**, the mapper and locator engine **244**, the data transmitter **246**, the privacy architecture **508**, the object tracking engine **510**, the eye tracking engine **512**, the body/head pose tracking engine **514**, the content selector **542**, the content manager **530**, the operation modality manager **540**, and the rendering engine **550** may be located in separate computing devices.

[0065] In some implementations, the functions and/or components of the controller **110** are combined with or provided by the electronic device **120** shown below in FIG. **3**. Moreover, FIG. **2** is intended more as a functional description of the various features which may be present in a particular implementation as opposed to a structural schematic of the implementations described herein. As recognized by those of ordinary skill in the art, items shown separately could be combined and some items could be separated. For example, some functional modules shown separately in FIG. **2** could be implemented in a single module and the various functions of single functional blocks could be implemented by one or more functional blocks in various implementations. The actual number of modules and the division of particular functions and how features are allocated among them will vary from one implementation to another and, in some implementations, depends in part on the particular combination of hardware, software, and/or firmware chosen for a particular implementation.

[0066] FIG. **3** is a block diagram of an example of the electronic device **120** (e.g., a mobile phone, tablet, laptop, near-eye system, wearable computing device, or the like) in accordance with some implementations. While certain specific features are illustrated, those skilled in the art will appreciate from the present disclosure that various other features have not been illustrated for the sake of brevity, and so as not to obscure more pertinent aspects of the implementations disclosed herein. To that end, as a non-limiting example, in some implementations, the electronic device **120** includes one or more processing units **302** (e.g., microprocessors, ASICs, FPGAs, GPUs, CPUs, processing cores, and/or the like), one or more input/output (I/O) devices and sensors **306**, one or more communication interfaces **308** (e.g., USB, IEEE 802.3x, IEEE 802.11x, IEEE 802.16x, GSM, CDMA, TDMA, GPS, IR, BLUETOOTH, ZIGBEE, and/or the like type interface), one or more programming (e.g., I/O) interfaces **310**, one or more displays **312**, an image capture device **370** (e.g., one or more optional interior- and/or exterior-facing image sensors), a memory **320**, and one or more communication buses **304** for interconnecting these and various other components.

[0067] In some implementations, the one or more communication buses **304** include circuitry that interconnects and controls communications between system components. In some implementations, the one or more I/O devices and sensors **306** include at least one of an inertial measurement unit (IMU), an accelerometer, a gyroscope, a magnetometer, a thermometer, one or more physiological sensors (e.g., blood pressure monitor, heart rate monitor, blood oximetry monitor, blood glucose monitor, etc.), one or more microphones, one or more speakers, a haptics engine, a heating and/or cooling unit, a skin shear engine, one or more depth sensors (e.g., structured light, time-of-flight, LiDAR, or the like), a localization and mapping engine, an eye tracking engine, a body/head pose tracking engine, a hand/limb/finger/extremity tracking engine, a camera pose tracking engine, or the like.

[0068] In some implementations, the one or more displays **312** are configured to present the XR environment to the user. In some implementations, the one or more displays **312** are also configured to present flat video content to the user (e.g., a 2-dimensional or "flat" AVI, FLV, WMV, MOV, MP4, or the like file associated with a TV episode or a movie, or live video pass-through of the physical environment **105**). In some implementations, the one or more displays **312** correspond to touchscreen displays. In some implementations, the one or more displays **312** correspond to holographic, digital light processing (DLP), liquid-crystal display (LCD), liquid-crystal on silicon (LCoS), organic light-emitting field-effect transitory (OLET), organic light-emitting diode (OLED), surface-conduction electron-emitter display (SED), field-emission display (FED), quantum-dot light-emitting diode (QD-LED), micro-electro-mechanical system (MEMS), and/or the like display types. In some implementations, the one or more displays **312** correspond to diffractive, reflective, polarized, holographic, etc. waveguide displays. For example, the electronic device **120** includes a single display. In another example, the electronic device **120** includes a display for each eye of the user. In some implementations, the one or more displays **312** are capable of presenting AR and VR content. In some implementations, the one or more displays **312** are capable of presenting AR or VR content.

[0069] In some implementations, the image capture device **370** correspond to one or more RGB cameras (e.g., with a complementary metal-oxide-semiconductor (CMOS) image sensor or a charge-coupled device (CCD) image sensor), IR image sensors, event-based cameras, and/or the like. In some implementations, the image capture device **370** includes a lens assembly, a photodiode, and a front-end architecture. In some implementations, the image capture device **370** includes exterior-facing and/or interior-facing image sensors.

[0070] The memory **320** includes high-speed random-access memory, such as DRAM, SRAM, DDR RAM, or other random-access solid-state memory devices. In some implementations, the memory **320** includes non-volatile memory, such as one or more magnetic disk storage devices, optical disk storage devices, flash memory devices, or other non-volatile solid-state storage devices. The memory **320** optionally includes one or more storage devices remotely located from the one or more processing units **302**. The memory **320** comprises a non-transitory computer readable storage medium. In some implementations, the memory **320** or the non-transitory computer readable storage medium of the memory **320** stores the following programs, modules and data structures, or a subset thereof including an optional operating system **330** and a presentation engine **340**.

[0071] The operating system **330** includes procedures for handling various basic system services and for performing hardware dependent tasks. In some implementations, the presentation engine **340** is configured to present media items and/or XR content to the user via the one or more displays **312**. To that end, in various implementations, the presentation engine **340** includes a data obtainer **342**, a presenter **570**, an interaction handler **540**, and a data transmitter **350**.

[0072] In some implementations, the data obtainer **342** is configured to obtain data (e.g., presentation data such as rendered image frames associated with the user interface or the XR environment, input data, user interaction data, head tracking information, camera pose tracking information, eye tracking information, hand/limb/finger/extremity tracking information, sensor data, location data, etc.) from at least one of the I/O devices and sensors **306** of the electronic device **120**, the controller **110**, and the remote input devices. To that end, in various implementations, the data obtainer **342** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0073] In some implementations, the interaction handler **540** is configured to detect user interactions with the presented A/V content and/or XR content (e.g., gestural inputs detected via hand/extremity tracking, eye gaze inputs detected via eye tracking, voice commands, etc.). To that end, in various implementations, the interaction handler **540** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0074] In some implementations, the presenter **570** is configured to present and update A/V content and/or XR content (e.g., the rendered image frames associated with the user interface or the XR environment **128** including the VA(s), the XR content, one or more UI elements associated with the XR content, and/or the like) via the one or more displays **312**. To that end, in various implementations, the presenter **570** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0075] In some implementations, the data transmitter **350** is configured to transmit data (e.g., presentation data, location data, user interaction data, head tracking information, camera pose tracking information, eye tracking information, hand/limb/finger/extremity tracking information, etc.) to at least the controller **110**. To that end, in various implementations, the data transmitter **350** includes instructions and/or logic therefor, and heuristics and metadata therefor.

[0076] Although the data obtainer **342**, the interaction handler **540**, the presenter **570**, and the data transmitter **350** are shown as residing on a single device (e.g., the electronic device **120**), it should be understood that in other implementations, any combination of the data obtainer **342**, the interaction handler **540**, the presenter **570**, and the data transmitter **350** may be located in separate computing devices.

[0077] Moreover, FIG. **3** is intended more as a functional description of the various features which may be present in a particular implementation as opposed to a structural schematic of the implementations described herein. As recognized by those of ordinary skill in the art, items shown separately could be combined and some items could be separated. For example, some functional modules shown separately in FIG. **3** could be implemented in a single module and the various functions of single functional blocks could be implemented by one or more functional blocks in various implementations. The actual number of modules and the division of particular functions and how features are allocated among them will vary from one implementation to another and, in some implementations, depends in part on the particular combination of hardware, software, and/or firmware chosen for a particular implementation.

[0078] FIG. **4** is a block diagram of an exemplary control device **130** in accordance with some implementations. The control device **130** is sometimes simply called a stylus. The control device **130** includes non-transitory memory **402** (which optionally includes one or more computer readable storage mediums), a memory controller **422**, one or more processing units (CPUs) **420**, a peripherals interface **418**, RF circuitry **408**, an input/output (I/O) subsystem **406**, and other input or control devices **416**. The control device **130** optionally includes an external port **424** and one or more optical sensors **464**. The control device **130** optionally includes one or more contact intensity sensors **465** for detecting the intensity of contacts of the control device **130** on the electronic device **100** (e.g., when the control device **130** is used with a touch-sensitive surface such as the display **122** of the electronic device **120**) or on other surfaces (e.g., a desk surface). The control device **130** optionally includes one or more tactile output generators **463** for generating tactile outputs on the control device **130**. These components optionally communicate over one or more communication buses or signal lines **403**.

[0079] It should be appreciated that the control device **130** is only one example of an electronic stylus, and that the control device **130** optionally has more or fewer components than shown, optionally combines two or more components, or optionally has a different configuration or arrangement of the components. The various components shown in FIG. **4** are implemented in hardware, software, firmware, or a combination thereof, including one or more signal processing and/or application specific integrated circuits. In some implementations, some functions and/or operations of the control device **130** (e.g., the touch interpretation module **477**) are provided by the controller **110** and/or the electronic device **120**. As such, in some implementations, some components of the control device **130** are integrated into the controller **110** and/or the electronic device **120**.

[0080] As shown in FIG. **1**, the control device **130** includes a first end **176** and a second end **177**. In various embodiments, the first end **176** corresponds to a tip of the control device **130** (e.g., the tip of a pencil) and the second end **177** corresponds to the opposite or bottom end of the control device **130** (e.g., the eraser of the pencil).

[0081] As shown in FIG. **1**, the control device **130** includes a touch-sensitive surface **175** to receive touch inputs from the user **149**. In some implementations, the touch-sensitive surface **175** corresponds to a capacitive touch element. The control device **130** includes a sensor or set of sensors that detect inputs from the user based on haptic and/or tactile contact with the touch-sensitive surface **175**. In some implementations, the control device **130** includes any of a plurality of touch sensing technologies now known or later developed, including but not limited to capacitive, resistive, infrared, and surface acoustic wave technologies, as well as other proximity sensor arrays or other elements for determining one or more points of contact with the touch-sensitive surface **175**. Because the control device **130** includes a variety of sensors and types of sensors, the control device **130** can detect different a variety of inputs from the user **149**. In some implementations, the one or more sensors can detect a single touch input or successive touch inputs in response to a user tapping once or multiple times on the touch-sensitive surface **175**. In some implementations, the one or more sensors can detect a swipe input on the control device **130** in response to the user stroking along the touch-sensitive surface **175** with one or more fingers. In some implementations, if the speed with which the user strokes along the touch-sensitive surface **175** breaches a threshold, the one or more sensors detect a flick input rather than a swipe input.

[0082] The control device **130** also includes one or more sensors that detect orientation (e.g., angular position) and/or movement of the control device **130**, such as one or more accelerometers **467**, one or more gyroscopes **468**, one or more magnetometers **469**, and/or the like. The one or more sensors can detect a variety of rotational movements of the control device **130** by the user, including the type and direction of the rotation. For example, the one or more sensors can detect the user rolling and/or twirling the control device **130**, and can detect the direction (e.g., clockwise or counterclockwise) of the rolling/twirling. In some implementations, the detected input depends on the angular position of the first end **176** and the second end **177** of the control device **130** relative to the electronic device. For example, in some implementations, if the control device **130** is substantially perpendicular to the electronic device and the second end **177** (e.g., the eraser) is nearer to the electronic device, then contacting the surface of the electronic device with the second end **177** results in an erase operation. On the other hand, if the control device **130** is substantially perpendicular to the electronic device and the first end **176** (e.g., the tip) is nearer to the electronic device, then contacting the surface of the electronic device with the first end **176** results in a marking operation.

[0083] The memory **402** optionally includes high-speed random-access memory and optionally also includes non-volatile memory, such as one or more flash memory devices, or other non-volatile solid-state memory devices. Access to the memory **402** by other components of the control device **130**, such as the CPU(s) **420** and the peripherals interface **418**, is, optionally, controlled by the memory controller **422**.

[0084] The peripherals interface **418** can be used to couple input and output peripherals of the stylus to the CPU(s) **420** and the memory **402**. The one or more processors **420** run or execute various software programs and/or sets of instructions stored in the memory **402** to perform various functions for the control device **130** and to process data. In some implementations, the peripherals interface **418**, the CPU(s) **420**, and the memory controller **422** are, optionally, implemented on a single chip, such as chip **404**. In some other embodiments, they are, optionally, implemented on separate chips.

[0085] The RF (radio frequency) circuitry **408** receives and sends RF signals, also called electromagnetic signals. The RF circuitry **408** converts electrical signals to/from electromagnetic signals and communicates with the controller **110**, the electronic device **120**, and/or the like, communications networks, and/or other communications devices via the electromagnetic signals. The RF circuitry **408** optionally includes well-known circuitry for performing these functions, including but not limited to an antenna system, an RF transceiver, one or more amplifiers, a tuner, one or more oscillators, a digital signal processor, a CODEC chipset, a subscriber identity module (SIM) card, memory, and so forth. The RF circuitry **408** optionally communicates with networks, such as the Internet, also referred to as the World Wide Web (WWW), an intranet and/or a wireless network, such as a cellular telephone network, a wireless local area network (LAN) and/or a metropolitan area network (MAN), and other devices by wireless communication. The wireless communication optionally uses any of a plurality of communications standards, protocols and technologies, including but not limited to Global System for Mobile Communications (GSM), Enhanced Data GSM Environment (EDGE), high-speed downlink packet access (HSDPA), high-speed uplink packet access (HSUPA), Evolution, Data-Only (EV-DO), HSPA, HSPA+, Dual-Cell HSPA (DC-HSPA), long term evolution (LTE), near field communication (NFC), wideband code division multiple access (W-CDMA), code division multiple access (CDMA), time division multiple access (TDMA), BLUETOOTH, Wireless Fidelity (Wi-Fi) (e.g., IEEE 802.11a, IEEE 802.11ac, IEEE 802.11ax, IEEE 802.11b, IEEE 802.11g and/or IEEE 802.11n), or any other suitable communication protocol, including communication protocols not yet developed as of the filing date of this document.

[0086] The I/O subsystem **406** couples input/output peripherals on the control device **130**, such as the other input or control devices **416**, with the peripherals interface **418**. The I/O subsystem **406** optionally includes the optical sensor controller **458**, the intensity sensor controller **459**, the haptic feedback controller **461**, and the one or more input controllers **460** for other input or control devices. The one or more input controllers **460** receive/send electrical signals from/to the other input or control devices **416**. The other input or control devices **416** optionally include physical buttons (e.g., push buttons, rocker buttons, etc.), dials, slider switches, click wheels, and so forth. In some alternate embodiments, the input controller(s) **460** are, optionally, coupled with any (or none) of the following: an infrared port and/or a USB port.

[0087] The control device **130** also includes a power system **462** for powering the various components. The power system **462** optionally includes a power management system, one or more power sources (e.g., battery, alternating current (AC)), a recharging system, a power failure detection circuit, a power converter or inverter, a power status indicator (e.g., a light-emitting diode (LED)) and any other components associated with the generation, management and distribution of power in portable devices and/or portable accessories.

[0088] The control device **130** optionally also includes one or more optical sensors **464**. FIG. **4** shows an optical sensor coupled with optical sensor controller **458** in I/O subsystem **406**. The one or more optical sensors **464** optionally include charge-coupled device (CCD) or complementary metal-oxide semiconductor (CMOS) phototransistors. The one or more optical sensors **464** receive light from the environment, projected through one or more lens, and converts the light to data representing an image.

[0089] The control device **130** optionally also includes one or more contact intensity sensors **465**. FIG. **4** shows a contact intensity sensor coupled with intensity sensor controller **459** in the I/O subsystem **406**. The contact intensity sensors **465** optionally include one or more piezoresistive strain gauges, capacitive force sensors, electric force sensors, piezoelectric force sensors, optical force sensors, capacitive touch-sensitive surfaces, or other intensity sensors (e.g., sensors used to measure the force (or pressure) relative to a surface or relative to a grasp of the user **149**). The contact intensity sensors **465** receive contact intensity information (e.g., pressure information or a proxy for pressure information) from the environment. In some implementations, at least one contact intensity sensor is collocated with, or proximate to, a tip of the control device **130**. In some implementations, at least one contact intensity sensor is collocated with, or proximate to, the body of the control device **130**.

[0090] The control device **130** optionally also includes one or more proximity sensors **466**. FIG. **4** shows the one or more proximity sensors **466** coupled with the peripherals interface **418**. Alternately, the one or more proximity sensors **466** are coupled with the input controller **460** in the I/O subsystem **406**. In some implementations, the one or more proximity sensors **466** determine proximity of the control device **130** to an electronic device (e.g., the electronic device **120**).

[0091] The control device **130** optionally also includes one or more tactile output generators **463**. FIG. **4** shows a tactile output generator coupled with a haptic feedback controller **461** in the I/O subsystem **406**. The one or more tactile output generator(s) **463** optionally include one or more electroacoustic devices such as speakers or other audio components and/or electromechanical devices that convert energy into linear motion such as a motor, solenoid, electroactive polymer, piezoelectric actuator, electrostatic actuator, or other tactile output generating component (e.g., a component that converts electrical signals into tactile outputs on the electronic device). The one or more tactile output generator(s) **463** receive tactile feedback generation instructions from the haptic feedback module **433** and generates tactile outputs on the control device **130** that are capable of being sensed by a user of the control device **130**. In some implementations, at least one tactile output generator is collocated with, or proximate to, a length (e.g., a body or a housing) of the control device **130** and, optionally, generates a tactile output by moving the control device **130** vertically (e.g., in a direction parallel to the length of the control device **130**) or laterally (e.g., in a direction normal to the length of the control device **130**).

[0092] The control device **130** optionally also includes one or more accelerometers **467**, one or more gyroscopes **468**, and/or one or more magnetometers **469** (e.g., as part of an inertial measurement unit (IMU)) for obtaining information concerning the location and positional state of control device **130**. FIG. **4** shows sensors **467**, **468**, and **469** coupled with the peripherals interface **418**. Alternately, the sensors **467**, **468**, and **469** are, optionally, coupled with an input controller **460** in the I/O subsystem **406**. The control device **130** optionally includes a GPS (or GLONASS or other global navigation system) receiver (not shown) for obtaining information concerning the location of the control device **130**.

[0093] The control device **130** includes a touch-sensitive system **432**. The touch-sensitive system **432** detects inputs received at the touch-sensitive surface **175**. These inputs include the inputs discussed herein with respect to the touch-sensitive surface **175** of the control device **130**. For example, the touch-sensitive system **432** can detect tap inputs, twirl inputs, roll inputs, flick inputs, swipe inputs, and/or the like. The touch-sensitive system **432** coordinates with a touch interpretation module **477** in order to decipher the particular kind of touch input received at the touch-sensitive surface **175** (e.g., twirl/roll/flick/swipe/etc.).

[0094] In some implementations, the software components stored in the memory **402** include an operating system **426**, a communication module (or set of instructions) **428**, contact/motion module (or set of instructions) **430**, a position module (or set of instructions) **431**, and a Global Positioning System (GPS) module (or set of instructions) **435**. Furthermore, in some implementations, the memory **402** stores a device/global internal state **457**, as shown in FIG. **4**. Moreover, the memory **402** includes the touch interpretation module **477**. The device/global internal state **457** includes one or more of: sensor state, including information obtained from the stylus's various sensors and other input or control devices **416**; positional state, including information regarding the position and/or orientation of the control device **130** (e.g., translational and/or rotational values) and location information concerning the location of the control device **130**(e.g., determined by the GPS module **435**).

[0095] The operating system **426** (e.g., iOS, Darwin, RTXC, LINUX, UNIX, OS X, WINDOWS, or an embedded operating system such as VxWorks) includes various software components and/or drivers for controlling and managing general system tasks (e.g., memory management, power management, etc.) and facilitates communication between various hardware and software components. The communication module **428** optionally facilitates communication with other devices over one or more external ports **424** and also includes various software components for handling data received by the RF circuitry **408** and/or an external port **424**. The external port **424** (e.g., Universal Serial Bus (USB), FIREWIRE, etc.) is adapted for coupling directly to other devices or indirectly over a network (e.g., the Internet, wireless LAN, etc.).

[0096] The contact/motion module **430** optionally detects contact with the control device **130** and other touch-sensitive devices of control device **130** (e.g., buttons or other touch-sensitive components of the control device **130**). The contact/motion module **430** includes software components for performing various operations related to detection of contact (e.g., detection of a tip of the stylus with a touch-sensitive display, such as the display **122** of the electronic device **120**, or with another surface, such as a desk surface), such as determining if contact has occurred (e.g., detecting a touch-down event), determining an intensity of the contact (e.g., the force or pressure of the contact or a substitute for the force or pressure of the contact), determining if there is movement of the contact and tracking the movement (e.g., across the display **122** of the electronic device **120**), and determining if the contact has ceased (e.g., detecting a lift-off event or a break in contact). In some implementations, the contact/motion module **430** receives contact data from the I/O subsystem **406**. Determining movement of the point of contact, which is represented by a series of contact data, optionally includes determining speed (magnitude), velocity (magnitude and direction), and/or an acceleration (a change in magnitude and/or direction) of the point of contact. As noted above, in some implementations, one or more of these operations related to detection of contact are performed by the electronic device **120** or the controller **110** (in addition to or in place of the stylus using the contact/motion module **430**).

[0097] The contact/motion module **430** optionally detects a gesture input by control device **130**. Different gestures with the control device **130** have different contact patterns (e.g., different motions, timings, and/or intensities of detected contacts). Thus, a gesture is, optionally, detected by detecting a particular contact pattern. For example, detecting a single tap gesture includes detecting a touch-down event followed by detecting a lift-off event at the same position (or substantially the same position) as the touch-down event (e.g., at the position of an icon). As another example, detecting a swipe gesture includes detecting a touch-down event followed by detecting one or more stylus-dragging events, and subsequently followed by detecting a lift-off event. As noted above, in some implementations, gesture detection is performed by the electronic device using contact/motion module **430** (in addition to or in place of the stylus using contact/motion module **430**).

[0098] The position module **431**, in conjunction with the one or more accelerometers **467**, the one or more gyroscopes **468**, and/or the one or more magnetometers **469**, optionally detects positional information concerning the stylus, such as the attitude of the control device **130** (e.g., roll, pitch, and/or yaw) in a particular frame of reference. The position module **431**, in conjunction with the one or more accelerometers **467**, the one or more gyroscopes **468**, and/or the one or more magnetometers **469**, optionally detects movement gestures, such as flicks, taps, and rolls of the control device **130**. The position module **431** includes software components for performing various operations related to detecting the position of the stylus and detecting changes to the position of the stylus in a particular frame of reference. In some implementations, the position module **431** detects the positional state of the control device **130** relative to the physical environment **105** or the world-at-large and detects changes to the positional state of the control device **130**.

[0099] The haptic feedback module **433** includes various software components for generating instructions used by the one or more tactile output generators **463** to produce tactile outputs at one or more locations on the control device **130** in response to user interactions with the control device **130**. The GPS module **435** determines the location of the control device **130** and provides this information for use in various applications (e.g., to applications that provide location-based services such as an application to find missing devices and/or accessories).

[0100] The touch interpretation module **477** coordinates with the touch-sensitive system **432** in order to determine (e.g., decipher or identify) the type of touch input received at the touch-sensitive surface **175** of the control device **130**. For example, the touch interpretation module **477** determines that the touch input corresponds to a swipe input (as opposed to a tap input) if the user strokes a sufficient distance across the touch-sensitive surface **175** of the control device **130** in a sufficiently short amount of time. As another example, the touch interpretation module **477** determines that the touch input corresponds to a flick input (as opposed to a swipe input) if the speed with which user strokes across the touch-sensitive surface **175** of the control device **130** is sufficiently faster than the speed corresponding to a swipe input. The threshold speeds of strokes can be preset and can be changed. In various embodiments, the pressure and/or force with which the touch is received at the touch-sensitive surface determines the type of input. For example, a light touch can correspond to a first type of input while a harder touch can correspond to a second type of input.

[0101] Each of the above identified modules and applications correspond to a set of executable instructions for performing one or more functions described above and the methods described in this application (e.g., the computer-implemented methods and other information processing methods described herein). These modules (i.e., sets of instructions) need not be implemented as separate software programs, procedures or modules, and thus various subsets of these modules are, optionally, combined or otherwise re-arranged in various embodiments. In some implementations, the memory **402** optionally stores a subset of the modules and data structures identified above. Furthermore, the memory **402** optionally stores additional modules and data structures not described above.

[0102] FIG. **5**A is a block diagram of a first portion **500**A of an example content delivery architecture in accordance with some implementations. While pertinent features are shown, those of ordinary skill in the art will appreciate from the present disclosure that various other features have not been illustrated for the sake of brevity and so as not to obscure more pertinent aspects of the example implementations disclosed herein. To that end, as a non-limiting example, the content delivery architecture is included in a computing system such as the controller **110** shown in FIGS. **1** and **2**; the electronic device **120** shown in FIGS. **1** and **3**; and/or a suitable combination thereof.

[0103] As shown in FIG. **5**A, one or more local sensors **502** of the controller **110**, the electronic device **120**, and/or a combination thereof obtain local sensor data **503** associated with the physical environment **105**. For example, the local sensor data **503** includes images or a stream thereof of the physical environment **105**, simultaneous location and mapping (SLAM) information for the physical environment **105** and the location of the electronic device **120** or the user **149** relative to the physical environment **105**, ambient lighting information for the physical environment **105**, ambient audio information for the physical environment **105**, acoustic information for the physical environment **105**, dimensional information for the physical environment **105**, semantic labels for objects within the physical environment **105**, and/or the like. In some implementations, the local sensor data **503** includes un-processed or post-processed information.

[0104] Similarly, as shown in FIG. **5**A, one or more remote sensors **504**, associated with the optional remote input devices within the physical environment **105**, the control device **130**, and/or the like, obtain remote sensor data **505** associated with the physical environment **105**. For example, the remote sensor data **505** includes images or a stream thereof of the physical environment **105**, SLAM information for the physical environment **105** and the location of the electronic device **120** or the user **149** relative to the physical environment **105**, ambient lighting information for the physical environment **105**, ambient audio information for the physical environment **105**, acoustic information for the physical environment **105**, dimensional information for the physical environment **105**, semantic labels for objects within the physical environment **105**, and/or the like. In some implementations, the remote sensor data **505** includes un-processed or post-processed information.

[0105] As shown in FIG. **5**A, tracking data **506** is obtained by at least one of the controller **110**, the electronic device

120, or the control device 130 in order to localize and track the control device 130. As one example, the tracking data 506 includes images or a stream thereof of the physical environment 105 captured by exterior-facing image sensors of the electronic device 120 that includes the control device 130. As another example, the tracking data 506 corresponds to IMU information, accelerometer information, gyroscope information, magnetometer information, and/or the like from integrated sensors of the control device 130.

[0106] According to some implementations, the privacy architecture 508 ingests the local sensor data 503, the remote sensor data 505, and the tracking data 506. In some implementations, the privacy architecture 508 includes one or more privacy filters associated with user information and/or identifying information. In some implementations, the privacy architecture 508 includes an opt-in feature where the electronic device 120 informs the user 149 as to what user information and/or identifying information is being monitored and how the user information and/or the identifying information will be used. In some implementations, the privacy architecture 508 selectively prevents and/or limits the content delivery architecture 500A/500B or portions thereof from obtaining and/or transmitting the user information. To this end, the privacy architecture 508 receives user preferences and/or selections from the user 149 in response to prompting the user 149 for the same. In some implementations, the privacy architecture 508 prevents the content delivery architecture 500A/500B from obtaining and/or transmitting the user information unless and until the privacy architecture 508 obtains informed consent from the user 149. In some implementations, the privacy architecture 508 anonymizes (e.g., scrambles, obscures, encrypts, and/or the like) certain types of user information. For example, the privacy architecture 508 receives user inputs designating which types of user information the privacy architecture 508 anonymizes. As another example, the privacy architecture 508 anonymizes certain types of user information likely to include sensitive and/or identifying information, independent of user designation (e.g., automatically).

[0107] According to some implementations, the object tracking engine 510 obtains the tracking data 506 after it has been subjected to the privacy architecture 508. In some implementations, the object tracking engine 510 determines/generates an object tracking vector 511 for a physical object based on the tracking data 506 and updates the object tracking vector 511 over time. As one example, the physical object corresponds to a proxy object detected within the physical environment 105 that lacks a communication channel to the computing system (e.g., the controller 110, the electronic device 120, and/or the like) such as a pencil, a pen, or the like. As another example, the physical object corresponds to an electronic device (e.g., the control device 130) with a wired or wireless communication channel to the computing system (e.g., the controller 110, the electronic device 120, and/or the like) such as a stylus, a finger-wearable device, a handheld device, or the like.

[0108] FIG. 5B shows an example data structure for the object tracking vector 511 in accordance with some implementations. As shown in FIG. 5B, the object tracking vector 511 may correspond to an N-tuple characterization vector or characterization tensor that includes a timestamp 571 (e.g., the most recent time the object tracking vector 511 was updated), one or more translational values 572 for a physical object (e.g., x, y, and z values relative to the physical environment 105, the world-at-large, and/or the like), one or more rotational values 574 for the physical object (e.g., roll, pitch, and yaw values), one or more input (pressure) values 576 associated with the physical object (e.g., a first input (pressure) value associated with contact between an end of the control device 130 and a surface, a second input (pressure) value associated with an amount of pressure exerted on a body of the control device 130 while grasped by the user 149, and/or the like), optional touch input information 578 (e.g., information associated with user touch inputs directed to the touch-sensitive surface 175 of the control device 130), and/or miscellaneous information 579. One of ordinary skill in the art will appreciate that the data structure for the object tracking vector 511 in FIG. 5B is merely an example that may include different information portions in various other implementations and be structured in myriad ways in various other implementations.

[0109] According to some implementations, the eye tracking engine 512 obtains the local sensor data 503 and the remote sensor data 505 after it has been subjected to the privacy architecture 508. In some implementations, the eye tracking engine 512 determines/generates an eye tracking vector 513 associated with a gaze direction of the user 149 based on the input data and updates the eye tracking vector 513 over time.

[0110] FIG. 5B shows an example data structure for the eye tracking vector 513 in accordance with some implementations. As shown in FIG. 5B, the eye tracking vector 513 may correspond to an N-tuple characterization vector or characterization tensor that includes a timestamp 581 (e.g., the most recent time the eye tracking vector 513 was updated), one or more angular values 582 for a current gaze direction of the user 149 (e.g., roll, pitch, and yaw values), one or more translational values 584 for the current gaze direction of the user 149 (e.g., x, y, and z values relative to the physical environment 105, the world-at-large, and/or the like), and/or miscellaneous information 586. One of ordinary skill in the art will appreciate that the data structure for the eye tracking vector 513 in FIG. 5B is merely an example that may include different information portions in various other implementations and be structured in myriad ways in various other implementations.

[0111] For example, the gaze direction indicates a point (e.g., associated with x, y, and z coordinates relative to the physical environment 105 or the world-at-large), a physical object, or a region of interest (ROI) in the physical environment 105 at which the user 149 is currently looking. As another example, the gaze direction indicates a point (e.g., associated with x, y, and z coordinates relative to the XR environment 128), an XR object, or a region of interest (ROI) in the XR environment 128 at which the user 149 is currently looking.

[0112] According to some implementations, the body/head pose tracking engine 514 obtains the local sensor data 503 and the remote sensor data 505 after it has been subjected to the privacy architecture 508. In some implementations, the body/head pose tracking engine 514 determines/generates a pose characterization vector 515 based on the input data and updates the pose characterization vector 515 over time.

[0113] FIG. 5B shows an example data structure for the pose characterization vector 515 in accordance with some implementations. As shown in FIG. 5B, the pose characterization vector 515 may correspond to an N-tuple characterization vector or characterization tensor that includes a timestamp **591** (e.g., the most recent time the pose characterization vector **515** was updated), a head pose descriptor **592**A (e.g., upward, downward, neutral, etc.), translational values for the head pose **592**B, rotational values for the head pose **592**C, a body pose descriptor **594**A (e.g., standing, sitting, prone, etc.), translational values for body sections/extremities/limbs/joints **594**B, rotational values for the body sections/extremities/limbs/joints **594**C, and/or miscellaneous information **596**. In some implementations, the pose characterization vector **515** also includes information associated with finger/hand/extremity tracking. One of ordinary skill in the art will appreciate that the data structure for the pose characterization vector **515** in FIG. **5**B is merely an example that may include different information portions in various other implementations and be structured in myriad ways in various other implementations.

[0114] According to some implementations, the data aggregator **521** obtains the object tracking vector **511**, the eye tracking vector **513**, and the pose characterization vector **515** (sometimes collectively referred to herein as an "input vector **519**"). In some implementations, the data aggregator **521** aggregates the object tracking vector **511**, the eye tracking vector **513**, and the pose characterization vector **515** and determines/generates a characterization vector **531** based thereon for subsequent downstream usage.

[0115] In some implementations, the content selection engine **522** determines a selected content portion **523** within the XR environment **128** based on the characterization vector **531** (or a portion thereof). For example, the content selection engine **522** determines the selected content portion **523** based on the current contextual information, the gaze direction of the user **149**, body pose information associated with the user **149**, head pose information associated with the user **149**, hand/extremity tracking information associated with the user **149**, positional information associated with the physical object, rotational information associated with the physical object, and/or the like. As one example, the content selection engine **522** performs a selection operation on a first portion of content based on a direction in which (e.g., a ray projecting from) a predetermined portion (e.g., an outward facing end) of the physical object is pointing in accordance with a determination that a grip pose, associated with a manner in which the physical object is being held by the user, corresponds to a first grip (e.g., the first grip=a pointing/wand-like grip). As another example, the content selection engine **522** performs a selection operation on a second portion of the content based on a gaze direction of the user in accordance with a determination that the grip pose, associated with the manner in which the physical object is being held by the user, does not correspond to the first grip.

[0116] In some implementations, the grip pose evaluator **524** determines a grip pose **525** associated with a current manner in which the physical object is being held by the user **149** based on the characterization vector **531** (or a portion thereof). For example, the grip pose evaluator **524** determines the grip pose **525** based on current contextual information, body pose information associated with the user **149**, head pose information associated with the user **149**, hand/extremity tracking information associated with the user **149**, positional information associated with the physical object, rotational information associated with the physical object, and/or the like. In some implementations, the grip pose **525** indicates a manner in which the user **149** grasps the physical object. For example, the grip pose **525** corresponds to one of a remote-control-esque grip, a wand-esque grip, a writing grip, an inverse writing grip, a handle grip, a thumb top grip, a level-esque grip, a gamepad-esque grip, a flute-esque grip, a fire-starter-esque grip, or the like.

[0117] In some implementations, the output modality selector **526** selects a current output modality **527** associated with a manner in which the physical object interacts with the XR environment **128** or manipulates the XR environment **128**. For example, a first output modality corresponds to selecting/manipulating object(s)/content within the XR environment **128**, and a second output modality corresponds to sketching, drawing, writing, etc. within the XR environment **128**. As one example, the output modality selector **526** selects a first output modality associated as a current output modality **527** for the physical object in accordance with a determination that movement of the physical object causes the physical object to breach a distance threshold relative to a first graphical element among the first plurality of graphical elements. As another example, the output modality selector **526** selects a second output modality as a current output modality **527** for the physical object in accordance with a determination that movement of the physical object causes the physical object to breach a distance threshold relative to a second graphical element among the first plurality of graphical elements.

[0118] In some implementations, the parameter adjustor **528** adjusts a parameter value **529** (e.g., the thickness, brightness, color, texture, etc. of marks) associated with a marking input directed to the XR environment **128** based on either a first input (pressure) value or a second input (pressure) value associated with the physical object. As one example, the parameter adjustor **528** adjusts the parameter value **529** associated with a detected marking input directed to the XR environment **128** based on how hard the physical object is being pressed against the physical surface (e.g., a first input (pressure) value) in accordance with a determination that the marking input is directed to a physical surface (e.g., a tabletop, another planar surface, or the like). As another example, the parameter adjustor **528** adjusts the parameter value **529** associated with a detected marking input directed to the XR environment **128**) based on how hard the physical object is being grasped by the user **149** (e.g., a second input (pressure) value) in accordance with a determination that the marking input is not directed to a physical surface In this example, the marking input is detected while the physical object or a predefined portion of the physical object such as a tip of the physical object is not in contact with any physical surface in the physical environment **105**.

[0119] FIG. **5**C is a block diagram of a second portion **500**B of the example content delivery architecture in accordance with some implementations. While pertinent features are shown, those of ordinary skill in the art will appreciate from the present disclosure that various other features have not been illustrated for the sake of brevity and so as not to obscure more pertinent aspects of the example implementations disclosed herein. To that end, as a non-limiting example, the content delivery architecture is included in a computing system such as the controller **110** shown in FIGS. **1** and **2**; the electronic device **120** shown in FIGS. **1** and **3**; and/or a suitable combination thereof. FIG. **5**C is similar to and adapted from FIG. **5**A. Therefore, similar reference numbers are used in FIGS. **5**A and **5**C. As such, only the differences between FIGS. **5**A and **5**C will be described below for the sake of brevity.

[0120] According to some implementations, the interaction handler **540** obtains (e.g., receives, retrieves, or detects) one or more user inputs **541** provided by the user **149** that are associated with selecting A/V content, one or more VAs, and/or XR content for presentation. For example, the one or more user inputs **541** correspond to a gestural input modifying and/or manipulating the XR content or VA(s) within the XR environment **128** detected via hand/extremity tracking, a gestural input selecting XR content within the XR environment **128** or from a UI menu detected via hand/extremity tracking, an eye gaze input selecting XR content the XR environment **128** or from the UI menu detected via eye tracking, a voice command selecting XR content the XR environment **128** or from the UI menu detected via a microphone, and/or the like. In some implementations, the content selector **542** selects XR content **547** from the content library **545** based on one or more user inputs **541**.

[0121] In various implementations, the content manager **530** manages and updates the layout, setup, structure, and/or the like for the XR environment **128**, including one or more of VAs, XR content, one or more UI elements associated with the XR content, and/or the like, based on the selected content portion **523**, the grip pose **525**, the output modality **527**, the parameter value **529**, the characterization vector **531**, and/or the like. To that end, the content manager **530** includes the buffer **534**, the content updater **536**, and the feedback engine **538**.

[0122] In some implementations, the buffer **534** includes XR content, a rendered image frame, and/or the like for one or more past instances and/or frames. In some implementations, the content updater **536** modifies the XR environment **128** over time based on the selected content portion **523**, the grip pose **525**, the output modality **527**, the parameter value **529**, the characterization vector **531**, the user inputs **541** associated with modifying and/or manipulating the XR content or VA(s), translational or rotational movement of objects within the physical environment **105**, translational or rotational movement of the electronic device **120** (or the user **149**), and/or the like. In some implementations, the feedback engine **538** generates sensory feedback (e.g., visual feedback such as text or lighting changes, audio feedback, haptic feedback, etc.) associated with the XR environment **128**.

[0123] According to some implementations, with reference to the rendering engine **550** in FIG. **5**C, the pose determiner **552** determines a current camera pose of the electronic device **120** and/or the user **149** relative to the XR environment **128** and/or the physical environment **105** based at least in part on the pose characterization vector **515**. In some implementations, the renderer **554** renders the VA(s), the XR content **547**, one or more UI elements associated with the XR content, and/or the like according to the current camera pose relative thereto.

[0124] According to some implementations, the optional image processing architecture **562** obtains an image stream from an image capture device **370** including one or more images of the physical environment **105** from the current camera pose of the electronic device **120** and/or the user **149**. In some implementations, the image processing architecture **562** also performs one or more image processing operations on the image stream such as warping, color correction, gamma correction, sharpening, noise reduction, white balance, and/or the like. In some implementations, the optional compositor **564** composites the rendered XR content with the processed image stream of the physical environment **105** from the image processing architecture **562** to produce rendered image frames of the XR environment **128**. In various implementations, the presenter **570** presents the rendered image frames of the XR environment **128** to the user **149** via the one or more displays **312**. One of ordinary skill in the art will appreciate that the optional image processing architecture **562** and the optional compositor **564** may not be applicable for fully virtual environments (or optical see-through scenarios).

[0125] FIGS. **6**A-**6**P illustrate a sequence of instances **610-6160** for a content delivery scenario in accordance with some implementations. While certain specific features are illustrated, those skilled in the art will appreciate from the present disclosure that various other features have not been illustrated for the sake of brevity, and so as not to obscure more pertinent aspects of the implementations disclosed herein. To that end, as a non-limiting example, the sequence of instances **610-6160** are rendered and presented by a computing system such as the controller **110** shown in FIGS. **1** and **2**; the electronic device **120** shown in FIGS. **1** and **3**; and/or a suitable combination thereof.

[0126] As shown in FIGS. **6**A-**6**P, the content delivery scenario includes a physical environment **105** and an XR environment **128** displayed on the display **122** of the electronic device **120** (e.g., associated with the user **149**). The electronic device **120** presents the XR environment **128** to the user **149** while the user **149** is physically present within the physical environment **105** that includes a door **115**, which is currently within the FOV **111** of an exterior-facing image sensor of the electronic device **120**. As such, in some implementations, the user **149** holds the electronic device **120** in his/her left hand **150** similar to the operating environment **100** in FIG. **1**.

[0127] In other words, in some implementations, the electronic device **120** is configured to present XR content and to enable optical see-through or video pass-through of at least a portion of the physical environment **105** on the display **122** (e.g., the door **115** or a representation thereof). For example, the electronic device **120** corresponds to a mobile phone, tablet, laptop, near-eye system, wearable computing device, or the like.

[0128] As shown in FIG. **6**A, during the instance **610** (e.g., associated with time T_1) of the content delivery scenario, the electronic device **120** presents the XR environment **128** including a representation **116** of the door **115** and a virtual agent (VA) **606**. As shown in FIG. **6**A, the control device **130** is neither currently held by the user **149** nor detecting any inputs directed to its touch-sensitive surface **175**.

[0129] FIGS. **6**B and **6**C illustrate a sequence in which a first plurality of graphical elements associated with a first plurality of output modalities are displayed within the XR environment **128** in response to detecting a touch input directed to the control device **130**. As shown in FIG. **6**B, during the instance **620** (e.g., associated with time T_2) of the content delivery scenario, the control device **130** detects a swipe input **622** directed to the touch-sensitive surface **175**. In some implementations, the control device **130** provides an indication of the swipe input **622** to the controller **110** and/or the electronic device **120**. In some implementations, the control device **130** communicates with the electronic device **120** and/or the controller **130**.

[0130] As shown in FIG. **6**C, during the instance **630** (e.g., associated with time T_3) of the content delivery scenario, the electronic device **120** displays graphical elements **632**A, **632**B, **632**C, and **632**D (sometimes collectively referred to herein as a first plurality of graphical elements **632**) in response to obtaining the indication of the swipe input **622** directed to the touch-sensitive surface **175** of the control device **130** in FIG. **6**B or detecting the swipe input **622** directed to the touch-sensitive surface **175** of the control device **130** in FIG. **6**B.

[0131] Furthermore, as shown in FIG. **6**C, the electronic device **120** displays a representation **153** of the right hand **152** of the user **149** gripping a representation **131** of the control device **130**. For example, the right hand **152** of the user **149** is currently gripping the control device **130** with a pointing grip pose. In some implementations, the first plurality of graphical elements **632** are a function of the current grip pose. For example, the graphical element **632**A corresponds to an output modality associated with generating pencil-like marks within the XR environment **128**, the graphical element **632**B corresponds to an output modality associated with generating pen-like marks within the XR environment **128**, the graphical element **632**C corresponds to an output modality associated with generating marker-like marks within the XR environment **128**, and the graphical element **632**D corresponds to an output modality associated with generating airbrush-like marks within the XR environment **128**.

[0132] In FIG. **6**C, a spatial location of the representation **131** of the control device **130** is outside of an activation region **634** associated with the graphical element **632**D. In some implementations, the activation region **634** corresponds to a predetermined distance threshold such as an X cm radius surrounding the graphical element **632**D. In some implementations, the activation region **634** corresponds to a deterministic distance threshold surrounding the graphical element **632**D.

[0133] FIGS. **6**D and **6**E illustrate a sequence in which a first output modality (e.g., airbrush marking) is selected for the control device **130** in accordance with a determination that a movement of the control device **130** causes the control device **130** (or the representation thereof) to breach the activation region **634** (e.g., the distance threshold) relative to the graphical element **632**D. As shown in FIG. **6**D, during the instance **640** (e.g., associated with time T_4) of the content delivery scenario, the electronic device **120** detects movement of the control device **130** that causes the spatial location of the representation **131** of the control device **130** to breach (or enter) the activation region **634** (e.g., the distance threshold) relative to the graphical element **632**D. In response to detecting that the movement of the control device **130** that causes the spatial location of the representation **131** of the control device **130** to breach the activation region **634** relative to the graphical element **632**D, the electronic device **120** changes the appearance of the graphical element **632**D to indicate its selection by displaying a border or frame **642** around the graphical element **632**D. One of ordinary skill in the art will appreciate that the appearance of the graphical element **632**D may be changed in other ways to indicate its selection such as by changing its brightness, color, texture, shape, size, glow, shadow, and/or the like.

[0134] As shown in FIG. **6**E, during the instance **650** (e.g., associated with time T_5) of the content delivery scenario, the electronic device **120** ceases to display the graphical elements **632**A, **632**B, and **632**C in response to detecting that the movement of the control device **130** that causes the spatial location of the representation **131** of the control device **130** to breach the activation region **634** relative to the graphical element **632**D in FIG. **6**D.

[0135] Furthermore, in FIG. **6**E, the electronic device **120** displays the graphical elements **632**D overlaid on a tip of the representation **131** of the control device **130** within the XR environment **128** in response to detecting that the movement of the control device **130** that causes the spatial location of the representation **131** of the control device **130** to breach the activation region **634** relative to the graphical element **632**D in FIG. **6**D. In some implementations, in response to selection of the graphical element **632**D, the graphical element **632**D remains anchored to the tip of the representation **131** of the control device **130** as shown in FIGS. **6**E and **6**F.

[0136] FIGS. **6**E and **6**F illustrate a sequence in which detection of a marking input causes one or more marks to be displayed within the XR environment **128** according to the currently selected first output modality (e.g., airbrush marks). As shown in FIG. **6**E, during the instance **650** (e.g., associated with time T_5) of the content delivery scenario, the electronic device **120** detects a marking input **654** with the control device **130** by way of hand/extremity tracking. As shown in FIG. **6**F, during the instance **660** (e.g., associated with time T_6) of the content delivery scenario, the electronic device **120** displays an airbrush-like mark **662** within the XR environment **128** in response to detecting the marking input **654** in FIG. **6**E. For example, the shape, depth, length, angle, etc. of the airbrush-like mark **662** corresponds to spatial parameters of the marking input **654** (e.g., positional values, rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc. associated with the marking input).

[0137] FIGS. **6**G-**6**I illustrate a sequence in which a second output modality (e.g., pen marking) is selected for the control device **130** in accordance with a determination that a movement of the control device **130** causes the control device **130** (or the representation thereof) to breach the activation region **634** (e.g., the distance threshold) relative to the graphical element **632**B. As shown in FIG. **6**G, during the instance **670** (e.g., associated with time T_7) of the content delivery scenario, the electronic device **120** displays graphical elements **632**A, **632**B, **632**C, and **632**D (sometimes collectively referred to herein as the first plurality of graphical elements **632**) in response to obtaining the indication of the swipe input **622** directed to the touch-sensitive surface **175** of the control device **130** in FIG. **6**B or detecting the swipe input **622** directed to the touch-sensitive surface **175** of the control device **130** in FIG. **6**B.

[0138] As shown in FIG. **6**H, during the instance **680** (e.g., associated with time T_8) of the content delivery scenario, the electronic device **120** detects movement of the control device **130** that causes the spatial location of the representation **131** of the control device **130** to breach (or enter) the activation region **634** (e.g., the distance threshold) relative to the graphical element **632**B. In response to detecting that the movement of the control device **130** that causes the spatial location of the representation **131** of the control device **130** to breach the activation region **634** relative to the graphical element **632**D, the electronic device **120** changes the appearance of the graphical element **632**B to indicate its selection by displaying a border or frame **642** around the graphical element **632**B. One of ordinary skill in the art will appreciate that the appearance of the graphical element **632**B may be changed in other ways to indicate its selection such as by changing its brightness, color, texture, shape, size, glow, shadow, and/or the like.

[0139] As shown in FIG. **6**I, during the instance **690** (e.g., associated with time T_9) of the content delivery scenario, the electronic device **120** ceases to display the graphical elements **632**A, **632**C, and **632**D in response to detecting that the movement of the control device **130** that causes the spatial location of the representation **131** of the control device **130** to breach the activation region **634** relative to the graphical element **632**B in FIG. **6**H. In some implementations, in response to selection of the graphical element **632**B, the graphical element **632**B remains anchored to the tip of the representation **131** of the control device **130** as shown in FIGS. **6**I-**6**N.

[0140] FIGS. **6**J and **6**K illustrate a sequence in which detection of a first marking input causes one or more marks to be displayed within the XR environment **128** according to the currently selected second output modality (e.g., pen marking) and the current measurement of the input (pressure) value. As shown in FIG. **6**J, during the instance **6100** (e.g., associated with time T_{10}) of the content delivery scenario, the electronic device **120** detects a marking input **6104** with the control device **130** by way of hand/extremity tracking. While the marking input **6104** is detected, the electronic device **120** also detects an input (pressure) value or obtains an indication of the input (pressure) value associated with how hard the control device **130** is being grasped by the right hand **152** of the user **149**. As one example, the input (pressure) value is detected by one or more pressure sensors integrated into the body of the control device **130**. As another example, the input (pressure) value is detected by analyzing finger/skin deformation or the like within one or more images captured by an exterior-facing image sensor of the electronic device **120** with a computer vision technique. As shown in FIG. **6**J, an input (pressure) value indicator **6102** indicates a current measurement **6103** of the input (pressure) value associated with how hard the control device **130** is being grasped by the user **149**. According to some implementations, the input (pressure) value indicator **6102** is an illustration to guide the reader that may or may not be displayed by the electronic device **120**.

[0141] As shown in FIG. **6**K, during the instance **6110** (e.g., associated with time T_{11}) of the content delivery scenario, the electronic device **120** displays a pen-like mark **6112** within the XR environment **128** in response to detecting the marking input **6104** in FIG. **6**J. For example, the shape, depth, length, angle, etc. of the pen-like mark **6112** corresponds to the spatial parameters of the marking input **6104**. Furthermore, in FIG. **6**K, the pen-like mark **6112** is associated with a first thickness value, which corresponds to the current measurement **6103** of the input (pressure) value in FIGS. **6**J.

[0142] FIGS. **6**L and **6**M illustrate a sequence in which detection of a second marking input causes one or more marks to be displayed within the XR environment **128** according to the currently selected second output modality (e.g., pen marking) and the current measurement of the input (pressure) value. As shown in FIG. **6**L, during the instance **6120** (e.g., associated with time T_{12}) of the content delivery scenario, the electronic device **120** detects a marking input **6122** with the control device **130** by way of hand/extremity tracking. While the marking input **6122** is detected, the electronic device **120** also detects an input (pressure) value or obtains an indication of the input (pressure) value associated with how hard the control device **130** is being grasped by the right hand **152** of the user **149**. As shown in FIG. **6**L, the input (pressure) value indicator **6102** indicates a current measurement **6123** of the input (pressure) value associated with how hard the control device **130** is being grasped by the user **149**. The current measurement **6123** of the input (pressure) value in FIG. **6**L is greater than the measurement **6103** of the input (pressure) value in FIG. **6**J.

[0143] As shown in FIG. **6**M, during the instance **6130** (e.g., associated with time T_{13}) of the content delivery scenario, the electronic device **120** displays a pen-like mark **6132** within the XR environment **128** in response to detecting the marking input **6122** in FIG. **6**L. For example, the shape, depth, length, angle, etc. of the pen-like mark **6132** corresponds to the spatial parameters of the marking input **6122**. Furthermore, in FIG. **6**M, the pen-like mark **6132** is associated with a second thickness value, which corresponds to the current measurement **6123** of the input (pressure) value in FIGS. **6**L. The second thickness value associated with the pen-like mark **6132** in FIG. **6**M is greater than the first thickness value associated with the pen-like mark **6112** in FIG. **6**K.

[0144] FIGS. **6**N and **6**O illustrate a sequence in which a second plurality of graphical elements associated with a second plurality of output modalities are displayed within the XR environment **128** in response to detecting a touch input directed to the control device **130**. As shown in FIG. **6**N, during the instance **6140** (e.g., associated with time T_{14}) of the content delivery scenario, the control device **130** detects a swipe input **6142** directed to the touch-sensitive surface **175**. In some implementations, the control device **130** provides an indication of the swipe input **6142** to the controller **110** and/or the electronic device **120**.

[0145] As shown in FIG. **6**O, during the instance **6150** (e.g., associated with time T_{15}) of the content delivery scenario, the electronic device **120** displays graphical elements **6152**A, **6152**B, **6152**C, and **6152**D (sometimes collectively referred to herein as a second plurality of graphical elements **6152**) in response to obtaining the indication of the swipe input **6142** directed to the touch-sensitive surface **175** of the control device **130** in FIG. **6**N or detecting the swipe input **6142** directed to the touch-sensitive surface **175** of the control device **130** in FIG. **6**N.

[0146] Furthermore, as shown in FIG. **6**O, the electronic device **120** displays a representation **153** of the right hand **152** of the user **149** gripping a representation **131** of the control device **130**. For example, the right hand **152** of the user **149** is currently gripping the control device **130** with a writing grip pose with a first end **176** pointed downward and a second end **177** pointed upward. In some implementations, the second plurality of graphical elements **6152** are a function of the current grip pose (e.g., the writing grip pose). For example, the graphical element **6152**A corresponds to an output modality associated with generating pencil-like marks within the XR environment **128**, the graphical element **6152**B corresponds to an output modality associated with generating pen-like marks within the XR environment **128**, the graphical element **6152**C corresponds to an output modality associated with generating narrow brush-like marks within the XR environment **128**, and the graphical element **6152**D corresponds to an output modality associated with generating wide brush-like marks within the XR environment **128**.

[0147] FIGS. **6**O and **6**P illustrate a sequence in which a third plurality of graphical elements associated with a third plurality of output modalities are displayed within the XR environment **128** in response to detecting a change in the current grip pose of the control device **130**. As shown in FIG. **6**O, during the instance **6150** (e.g., associated with time T_{15}) of the content delivery scenario, the electronic device **120** detects the current grip pose of the control device **130** with a computer vision technique whereby the right hand **152** of the user **149** is currently gripping the control device **130** with a writing grip pose with a first end **176** pointed downward and a second end **177** pointed upward. However, between FIGS. **6**O and **6**P, the electronic device **120** detects a change in the current grip pose of the control device **130** from the writing grip pose in FIG. **6**O to an inverse writing grip pose in FIG. **6**P.

[0148] As shown in FIG. **6**P, during the instance **6160** (e.g., associated with time T_{16}) of the content delivery scenario, the electronic device **120** detects the current grip pose of the control device **130** with a computer vision technique whereby the right hand **152** of the user **149** is currently gripping the control device **130** with the inverse writing grip pose with the first end **176** pointed upward and the second end **177** pointed downward. As such, the control device **130** was flipped **180**° relative to the orientation of its ends between FIGS. **6**O and **6**P. In FIG. **6**P, the electronic device **120** displays graphical elements **6162**A, **6162**B, **6162**C, and **6162**D (sometimes collectively referred to herein as a third plurality of graphical elements **6162**) in response to detecting the change in the current grip pose of the control device **130** from the writing grip pose in FIG. **6**O to the inverse writing grip pose in FIG. **6**P.

[0149] In some implementations, the third plurality of graphical elements **6162** are a function of the current grip pose (e.g., the inverse writing grip pose). For example, the graphical element **6162**A corresponds to an output modality associated with erasing or removing pixels within the XR environment **128** based on a first radius value, the graphical element **6162**B corresponds to an output modality associated with erasing or removing pixels within the XR environment **128** based on a second radius value greater than the first radius value, the graphical element **6162**C corresponds to an output modality associated with measuring marks within the XR environment **128**, and the graphical element **6162**D corresponds to an output modality associated with dissecting marks within the XR environment **128**.

[0150] FIGS. **7**A-**7**N illustrate a sequence of instances **710-7140** for a content delivery scenario in accordance with some implementations. While certain specific features are illustrated, those skilled in the art will appreciate from the present disclosure that various other features have not been illustrated for the sake of brevity, and so as not to obscure more pertinent aspects of the implementations disclosed herein. To that end, as a non-limiting example, the sequence of instances **710-7140** are rendered and presented by a computing system such as the controller **110** shown in FIGS. **1** and **2**; the electronic device **120** shown in FIGS. **1** and **3**; and/or a suitable combination thereof.

[0151] As shown in FIGS. **7**A-**7**N, the content delivery scenario includes a physical environment **105** and an XR environment **128** displayed on the display **122** of the electronic device **120** (e.g., associated with the user **149**). The electronic device **120** presents the XR environment **128** to the user **149** while the user **149** is physically present within the physical environment **105** that includes a position of a table **107** which is currently within the FOV **111** of an exterior-facing image sensor of the electronic device **120**. As such, in some implementations, the user **149** holds the electronic device **120** in his/her left hand **150** or right hand **152**.

[0152] In other words, in some implementations, the electronic device **120** is configured to present XR content and to enable optical see-through or video pass-through of at least a portion of the physical environment **105** on the display **122** (e.g., the table **107**). For example, the electronic device **120** corresponds to a mobile phone, tablet, laptop, near-eye system, wearable computing device, or the like.

[0153] As shown in FIG. **7**A, during the instance **710** (e.g., associated with time T_1) of the content delivery scenario, the electronic device **120** presents the XR environment **128** including a portion of the table **107**, a virtual agent (VA) **606**, an XR substrate **718** (e.g., a 2D or a 3D canvas), and a menu **712**. As shown in FIG. **7**A, the electronic device **120** also displays a representation **151** of the left hand **150** of the user **149** gripping a representation **131** of the control device **130** within the XR environment **128**. For example, the left hand **150** of the user **149** is currently gripping the control device **130** with a writing grip pose. As shown in FIG. **7**A, the menu **712** includes a plurality of selectable options **714** associated with changing the appearance of marks made within the XR environment (e.g., different colors, textures, etc.). For example, option **714**A is currently selected among the plurality of selectable options **714**. In this example, the option **714**A corresponds to a first appearance for marks made within the XR environment **128** (e.g., black marks). As shown in FIG. **7**A, the menu **712** also includes a slider **716** for adjusting the thickness of marks made within the XR environment **128**.

[0154] FIGS. **7**A and **7**B illustrate a sequence in which detection of a first marking input causes one or more marks to be displayed within the XR environment **128** according to a first measurement of an input (pressure) value. As shown in FIG. **7**A, during the instance **710** (e.g., associated with time T_1) of the content delivery scenario, the electronic device **120** detects a marking input **715** with the control device **130** by way of hand/extremity tracking. While the marking input **715** is detected, the electronic device **120** also detects an input (pressure) value or obtains an indication of the input (pressure) value associated with how hard the control device **130** is being grasped by the left hand **150** of the user **149**. As one example, the input (pressure) value is detected by one or more pressure sensors integrated into the body of the control device **130**. As another example, the input (pressure) value is detected by analyzing finger/skin deformation or the like within one or more images captured by an exterior-facing image sensor of the electronic device **120** with a computer vision technique. As shown in FIG. **7**A, an input (pressure) value indicator **717** indicates a current measurement **719** of the input (pressure) value associated with how hard the control device **130** is being grasped by the user **149**. According to some implementations, the input (pressure) value indicator **717** is an illustration to guide the reader that may or may not be displayed by the electronic device **120**.

[0155] As shown in FIG. **7**B, during the instance **720** (e.g., associated with time T_2) of the content delivery scenario, the electronic device **120** displays a mark **722** on the XR substrate **718** within the XR environment **128** in response to detecting the marking input **715** in FIG. **7**A. For example, the shape, depth, length, angle, etc. of the mark **722** corresponds to the spatial parameters of the marking input **715** (e.g., positional values, rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc. associated with the marking input). Furthermore, in FIG. **7**B, the mark **722** is associated with a first thickness value, which corresponds to the current measurement **719** of the input (pressure) value in FIG. **7**A.

[0156] FIGS. **7**C and **7**D illustrate a sequence in which detection of a second marking input causes one or more marks to be displayed within the XR environment **128** according to a second measurement of the input (pressure) value. As shown in FIG. **7**C, during the instance **730** (e.g., associated with time T_3) of the content delivery scenario, the electronic device **120** detects a marking input **732** with the control device **130** by way of hand/extremity tracking. While the marking input **732** is detected, the electronic device **120** also detects an input (pressure) value or obtains an indication of the input (pressure) value associated with how hard the control device **130** is being grasped by the left hand **150** of the user **149**. As shown in FIG. **7**C, the input (pressure) value indicator **717** indicates a current measurement **739** of the input (pressure) value associated with how hard the control device **130** is being grasped by the user **149**. For example, the current measurement **739** in FIG. **7**C is greater than the measurement **719** in FIG. **7**A.

[0157] As shown in FIG. **7**D, during the instance **740** (e.g., associated with time T_4) of the content delivery scenario, the electronic device **120** displays a mark **742** on the XR substrate **718** within the XR environment **128** in response to detecting the marking input **732** in FIG. **7**C. For example, the shape, depth, length, angle, etc. of the mark **742** corresponds to the spatial parameters of the marking input **732**. Furthermore, in FIG. **7**D, the mark **742** is associated with a second thickness value, which corresponds to the current measurement **739** of the input (pressure) value in FIGS. **7**C. For example, the second thickness value associated with the mark **742** is greater than the first thickness value associated with the mark **722**.

[0158] FIGS. **7**E and **7**F illustrate a sequence in which detection of a manipulation input causes one or more marks to be translated within the XR environment **128**. As shown in FIG. **7**E, during the instance **750** (e.g., associated with time T_5) of the content delivery scenario, the electronic device **120** detects a manipulation input **752** with the control device **130** that corresponds to translating the mark **742** within the XR environment **128**. While the manipulation input **752** is detected, the electronic device **120** also detects a touch input **754** directed to the touch-sensitive surface **175** of the control device **130** or obtains an indication of the touch input **754** directed to the touch-sensitive surface **175** of the control device **130**. As one example, the touch input **754** is detected by the touch-sensitive surface **175** of the control device **130**. As another example, the touch input **754** is detected by analyzing one or more images captured by an exterior-facing image sensor of the electronic device **120** with a computer vision technique.

[0159] As shown in FIG. **7**F, during the instance **760** (e.g., associated with time T_6) of the content delivery scenario, the electronic device **120** translates the mark **742** within the XR environment **128** in response to detecting the manipulation input **752** in FIG. **7**E while also detecting the touch input **754** directed to the touch-sensitive surface **175** of the control device **130** in FIG. **7**E. In some implementations, detection of the manipulation input **752** may be sufficient to cause translational movement of marks within the XR environment **128** without detecting the touch input **754** directed to the touch-sensitive surface **175** of the control device **130**. In some implementations, detection of the manipulation input **752** in concert with the detection of the touch input **754** directed to the touch-sensitive surface **175** of the control device **130** causes translational movement of marks within the XR environment **128**. For example, the angle, directionality, displacement, etc. of the translational movement of the mark **742** corresponds to the spatial parameters of the manipulation input **752** in FIG. **7**E. In some implementations, the manipulation input **752** may also cause rotational movement of the mark **742** based on rotational parameters of the manipulation input **752**.

[0160] FIGS. **7**G and **7**H illustrate a sequence in which detection of a first marking input causes one or more marks to be displayed within the XR environment **128** according to a first measurement of an input (pressure) value. As shown in FIG. **7**G, during the instance **770** (e.g., associated with time T_7) of the content delivery scenario, the electronic device **120** detects a marking input **772** with the control device **130** directed to an input region **774** on the table **107** by way of hand/extremity tracking. For example, the input region **774** corresponds to a portion of a plane associated with the surface of the table **107**. In some implementations, the input region **774** is visualized with an XR border or the like. In some implementations, the input region **774** is not visualized within the XR environment **128**.

[0161] While the marking input **772** is detected, the electronic device **120** also detects an input (pressure) value or obtains an indication of the input (pressure) value associated with how hard the control device **130** is being pressed against the table **107**. As one example, the input (pressure) value is detected by one or more pressure sensors integrated into one of the tips of the control device **130**. As another example, the input (pressure) value is detected by analyzing one or more images captured by an exterior-facing image sensor of the electronic device **120** with a computer vision technique. As shown in FIG. **7**G, the input (pressure) value indicator **777** indicates a current measurement **779** of the input (pressure) value associated with how hard the control device **130** is being pressed against the table **107**. According to some implementations, the input (pressure) value indicator **777** is an illustration to guide the reader that may or may not be displayed by the electronic device **120**.

[0162] As shown in FIG. **7**H, during the instance **780** (e.g., associated with time T_8) of the content delivery scenario, the electronic device **120** displays a mark **782**A on the XR substrate **718** within the XR environment **128** and a mark **782**B on the input region **774** in response to detecting the marking input **715** in FIG. **7**G. For example, the shape, depth, length, angle, etc. of the marks **782**A and **782**B corresponds to the spatial parameters of the marking input **772** in FIG. **7**G (e.g., positional values, rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc. associated with the marking input). Furthermore, in FIG. **7**H, the marks **782**A and

782B are associated with a first thickness value, which corresponds to the current measurement **779** of the input (pressure) value in FIG. 7G.

[0163] FIGS. **7**I and **7**J illustrate a sequence in which detection of a second marking input causes one or more marks to be displayed within the XR environment **128** according to a second measurement of the input (pressure) value. As shown in FIG. **7**I, during the instance **790** (e.g., associated with time T_9) of the content delivery scenario, the electronic device **120** detects a marking input **792** with the control device **130** directed to the input region **774** on the table **107** by way of hand/extremity tracking. While the marking input **792** is detected, the electronic device **120** also detects the input (pressure) value or obtains the indication of the input (pressure) value associated with how hard the control device **130** is being pressed against the table **107**. As shown in FIG. **7**I, the input (pressure) value indicator **777** indicates a current measurement **799** of the input (pressure) value associated with how hard the control device **130** is being pressed against the table **107**. For example, the current measurement **799** in FIG. **7**I is greater than the measurement **779** in FIG. **7**G.

[0164] As shown in FIG. **7**J, during the instance **7100** (e.g., associated with time T_{10}) of the content delivery scenario, the electronic device **120** displays a mark **7102**A on the XR substrate **718** within the XR environment **128** and a mark **7102**B on the input region **774** in response to detecting the marking input **792** in FIG. **7**I. For example, the shape, depth, length, angle, etc. of the marks **7102**A and **7102**B corresponds to the spatial parameters of the marking input **792** in FIG. **7**I (e.g., positional values, rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc. associated with the marking input). Furthermore, in FIG. **7**J, the marks **7102**A and **7102**B are associated with a second thickness value, which corresponds to the current measurement **799** of the input (pressure) value in FIGS. **7**I. For example, the second thickness value associated with the marks **7102**A and **7102**B is greater than the first thickness value associated with the marks **782**A and **782**B.

[0165] FIGS. **7**K and **7**L illustrate a sequence in which detection of a first content placement input causes first XR content to be displayed within the XR environment **128** according to the current measurement of the input (pressure) value. As shown in FIG. **7**K, during the instance **7110** (e.g., associated with time T_{11}) of the content delivery scenario, the electronic device **120** presents the XR environment **128** including the portion of the table **107**, the VA **606**, an XR substrate **7118** (e.g., a planar substrate), and a menu **7112**. As shown in FIG. **7**K, the menu **7112** includes a plurality of selectable options **7114** associated with changing the appearance of XR content placed within the XR environment (e.g., different shapes, colors, textures, etc.). For example, option **7114**A is currently selected among the plurality of selectable options **7114**. In this example, the option **7114**A corresponds to a first appearance for XR content placed within the XR environment **128**. As shown in FIG. **7**A, the menu **7112** also includes a slider **7116** for adjusting the size of XR content placed within the XR environment **128**.

[0166] As shown in FIG. **7**K, during the instance **7110** (e.g., associated with time T_{11}) of the content delivery scenario, the electronic device **120** detects a touch input **7111** directed to the touch-sensitive surface **175** of the control device **130** or obtains an indication of the touch input **7111** directed to the touch-sensitive surface **175** of the control device **130** while the representation **131** of the control device **130** is a distance **7115** above the XR substrate **7118**. As one example, the touch input **7111** is detected by the touch-sensitive surface **175** of the control device **130**. As another example, the touch input **7111** is detected by analyzing one or more images captured by an exterior-facing image sensor of the electronic device **120** with a computer vision technique. For example, the touch input **7111** corresponds to placing XR content (e.g., a cube) within the XR environment **128**. One of ordinary skill in the art will appreciate that other XR content may similarly be placed within the XR environment **128**.

[0167] While the touch input **7111** is detected, the electronic device **120** also detects an input (pressure) value or obtains an indication of the input (pressure) value associated with how hard the control device **130** is being grasped by the left hand **150** of the user **149**. As shown in FIG. **7**K, the input (pressure) value indicator **717** indicates a current measurement **7119** of the input (pressure) value associated with how hard the control device **130** is being grasped by the user **149**. According to some implementations, the input (pressure) value indicator **717** is an illustration to guide the reader that may or may not be displayed by the electronic device **120**.

[0168] As shown in FIG. **7**L, during the instance **7120** (e.g., associated with time T_{12}) of the content delivery scenario, the electronic device **120** displays first XR content **7122** a distance **7115** above the XR substrate **7118** within the XR environment **128** in response to detecting the touch input **7111** in FIG. **7**K. As shown in FIG. **7**L, the electronic device **120** also displays a shadow **7124** on the XR substrate **7118** associated with the first XR content **7122**. For example, the positional and rotational values of the first XR content **7122** and the shadow **7124** correspond to the parameters of the representation **131** of the control device **130** (e.g., positional values, rotational values, etc.) when the touch input **7111** was detected in FIG. **7**K. For example, the first XR content **7122** is associated with a first size value, which corresponds to the current measurement **7119** of the input (pressure) value in FIG. **7**K.

[0169] FIGS. **7**M and **7**N illustrate a sequence in which detection of a second content placement input causes second XR content to be displayed within the XR environment **128** according to the current measurement of the input (pressure) value. As shown in FIG. **7**M, during the instance **7130** (e.g., associated with time T_{13}) of the content delivery scenario, the electronic device **120** detects a touch input **7131** directed to the touch-sensitive surface **175** of the control device **130** or obtains an indication of the touch input **7131** directed to the touch-sensitive surface **175** of the control device **130** while the representation **131** of the control device **130** is in contact with the XR substrate **7118**.

[0170] While the touch input **7131** is detected, the electronic device **120** also detects an input (pressure) value or obtains an indication of the input (pressure) value associated with how hard the control device **130** is being grasped by the left hand **150** of the user **149**. As shown in FIG. **7**M, the input (pressure) value indicator **717** indicates a current measurement **7139** of the input (pressure) value associated with how hard the control device **130** is being grasped by the user **149**. According to some implementations, the input (pressure) value indicator **717** is an illustration to guide the reader that may or may not be displayed by the electronic device **120**.

[0171] As shown in FIG. 7N, during the instance **7140** (e.g., associated with time T_{14}) of the content delivery scenario, the electronic device **120** displays second XR content **7142** on the XR substrate **7118** within the XR environment **128** in response to detecting the touch input **7131** in FIG. 7M. As shown in FIG. 7N, the electronic device **120** does not display a shadow associated with the second XR content **7142** on the XR substrate **7118**. For example, the positional and rotational values of the second XR content **7142** correspond to the parameters of the representation **131** of the control device **130** (e.g., positional values, rotational values, etc.) when the touch input **7131** was detected in FIG. 7M. For example, the second XR content **7142** is associated with a second size value, which corresponds to the current measurement **7139** of the input (pressure) value in FIG. 7K. For example, the second size value associated with the second XR content **7142** is greater than the first size value associated with the first XR content **7122**.

[0172] FIGS. **8**A-**8**M illustrate a sequence of instances **810**-**8130** for a content delivery scenario in accordance with some implementations. While certain specific features are illustrated, those skilled in the art will appreciate from the present disclosure that various other features have not been illustrated for the sake of brevity, and so as not to obscure more pertinent aspects of the implementations disclosed herein. To that end, as a non-limiting example, the sequence of instances **810**-**8130** are rendered and presented by a computing system such as the controller **110** shown in FIGS. **1** and **2**; the electronic device **120** shown in FIGS. **1** and **3**; and/or a suitable combination thereof.

[0173] As shown in FIGS. **8**A-**8**M, the content delivery scenario includes a physical environment **105** and an XR environment **128** displayed on the display **122** of the electronic device **120** (e.g., associated with the user **149**). The electronic device **120** presents the XR environment **128** to the user **149** while the user **149** is physically present within the physical environment **105** that includes a door **115**, which is currently within the FOV **111** of an exterior-facing image sensor of the electronic device **120**. As such, in some implementations, the user **149** holds the electronic device **120** in his/her left hand **150** or right hand **152**.

[0174] In other words, in some implementations, the electronic device **120** is configured to present XR content and to enable optical see-through or video pass-through of at least a portion of the physical environment **105** on the display **122** (e.g., the door **115** or a representation thereof). For example, the electronic device **120** corresponds to a mobile phone, tablet, laptop, near-eye system, wearable computing device, or the like.

[0175] As shown in FIG. **8**A, during the instance **810** (e.g., associated with time T_1) of the content delivery scenario, the electronic device **120** presents the XR environment **128** including the representation **116** of the door **115** within the physical environment **105**, a virtual agent (VA) **606**, and XR content **802** (e.g., a cylinder). As shown in FIG. **8**A, the electronic device **120** also displays a gaze direction **806** associated with a focal point within the XR environment **128** of the eyes of the user **149** based on eye tracking. In some implementations, the gaze direction **806** is not displayed or visualized. As shown in FIG. **8**A, the electronic device **120** also displays a representation **153** of the right hand **152** of the user **149** gripping a representation **805** of a proxy object **804** (e.g., a stick, a ruler, or another physical object) within the XR environment **128**. For example, the right hand **152** of the user **149** is currently gripping the proxy object **804** with a pointing grip pose.

[0176] FIGS. **8**A and **8**B illustrate a sequence in which a size of an indicator element changes based on distance. As shown in FIG. **8**A, the representation **805** of the proxy object **804** is a first distance **814** from the XR content **802**, and the electronic device **120** displays a first indicator element **812**A with a first size on the XR content **802** that corresponds to a coincidence point between the XR content **802** and a ray emanating from a tip/end of the representation **805** of the proxy object **804**. In some implementations, a size of the first indicator element **812**A is a function of the first distance **814**. For example, the size of the indicator element increases as the distance decreases, and the size of the indicator element decreases as the distance increases.

[0177] As shown in FIG. **8**B, during the instance **820** (e.g., associated with time T_2) of the content delivery scenario, the electronic device **120** displays a second indicator element **812**B with a second size on the XR content **802** that corresponds to a coincidence point between the XR content **802** and a ray emanating from the tip/end of the representation **805** of the proxy object **804**. As shown in FIG. **8**B, the representation **805** of the proxy object **804** is a second distance **824** from the XR content **802**, which is less than the first distance **814** in FIG. **8**A. For example, the second size of the second indicator element **812**B is greater than the first size of the first indicator element **812**A.

[0178] FIGS. **8**B-**8**D illustrate a sequence in which XR content is selected in response to detecting a proxy object being pointed at the XR content and the XR content is translated in response to translational movement of the proxy object. In some implementations, the electronic device **120** selects the XR content **802** and changes its appearance in response to detecting the proxy object **804** being pointed at the XR content **802** for at least a predetermined time period. In some implementations, the electronic device **120** selects the XR content **802** and changes its appearance in response to detecting the proxy object **804** being pointed at the XR content **802** for at least a deterministic time period.

[0179] As shown in FIG. **8**C, during the instance **830** (e.g., associated with time T_3) of the content delivery scenario, the electronic device **120** changes the appearance of the XR content **802** to a cross-hatching appearance **802**A to visually indicate its selection in response to detecting the proxy object **804** being pointed at the XR content **802** for at least a predetermined or deterministic time period in FIGS. **8**A and **8**B. As shown in FIG. **8**C, the electronic device **120** also detects translational movement **832** of the proxy object **804** while the XR content **802**A is selected and the representation **805** of the proxy object **804** remains pointed at the XR content **802**A.

[0180] As shown in FIG. **8**D, during the instance **840** (e.g., associated with time T_4) of the content delivery scenario, the electronic device **120** translates the XR content **802** within the XR environment **128** in response to detecting the translational movement **832** of the proxy object **804** in FIG. **8**C. For example, the directionality and displacement of the translational movement of the XR content **802** within the XR environment **128** corresponds to the spatial parameters of the translational movement **832** in FIG. **8**C (e.g., change in positional values, change in rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc.). One of ordinary skill in the art will appreciate that the XR content **802** may be similarly rotated.

[0181] FIGS. **8**E-**8**G illustrate a sequence in which XR content is selected in response to detecting a gaze direction directed to the XR content and the XR content is translated based on translational movement of the gaze direction. In some implementations, the electronic device **120** selects the XR content **802** and changes its appearance in response to detecting the gaze direction **806** being directed to the XR content **802** for at least a predetermined time period. In some implementations, the electronic device **120** selects the XR content **802** and changes its appearance in response to detecting the gaze direction **806** being directed to the XR content **802** for at least a deterministic time period.

[0182] As shown in FIG. **8**E, during the instance **850** (e.g., associated with time T_5) of the content delivery scenario, the electronic device **120** displays a gaze direction indicator element **852** on the XR content **802** associated with a focal point within the XR environment **128** of the eyes of the user **149** based on eye tracking. For example, the gaze direction indicator element **852** corresponds to a coincidence point between the XR content **802** and rays emanating from the eyes for the user **149**. As shown in FIG. **8**E, the electronic device **120** also displays a representation **153** of the right hand **152** of the user **149** gripping a representation **131** of a control device **130** within the XR environment **128**. For example, the right hand **152** of the user **149** is currently gripping the control device **130** with a writing grip pose that is not pointed at any XR content within the XR environment **128**.

[0183] As shown in FIG. **8**F, during the instance **860** (e.g., associated with time T_6) of the content delivery scenario, the electronic device **120** changes the appearance of the XR content **802** to a cross-hatching appearance **802**A to visually indicate its selection in response to detecting the gaze direction **806** being directed to the XR content **802** for at least a predetermined or deterministic time period in FIG. **8**E. As shown in FIG. **8**F, the electronic device **120** also detects translational movement **862** of the gaze direction **806** while the XR content **802**A is selected.

[0184] As shown in FIG. **8**G, during the instance **870** (e.g., associated with time T_7) of the content delivery scenario, the electronic device **120** translates the XR content **802** within the XR environment **128** in response to detecting the translational movement **862** of the gaze direction **806** in FIG. **8**F. For example, the directionality and displacement of the translational movement of the XR content **802** within the XR environment **128** corresponds to the spatial parameters of the translational movement **862** of the gaze direction **806** in FIG. **8**F (e.g., change in positional values, change in rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc.).

[0185] FIGS. **8**H-**8**J illustrate another sequence in which XR content is selected in response to detecting a gaze direction directed to the XR content and the XR content is translated based on translational movement of the gaze direction. As shown in FIG. **8**H, during the instance **880** (e.g., associated with time T_8) of the content delivery scenario, the electronic device **120** displays a gaze direction indicator element **852** on the XR content **802** associated with a focal point within the XR environment **128** of the eyes of the user **149** based on eye tracking. For example, the gaze direction indicator element **852** corresponds to a coincidence point between the XR content **802** and rays emanating from the eyes for the user **149**. As shown in FIG. **8**H, the electronic device **120** detects neither the proxy object **804** nor the control device **130** being held by the user **149**.

[0186] As shown in FIG. **8**I, during the instance **890** (e.g., associated with time T_9) of the content delivery scenario, the electronic device **120** changes the appearance of the XR content **802** to a cross-hatching appearance **802**A to visually indicate its selection in response to detecting the gaze direction **806** being directed to the XR content **802** for at least a predetermined or deterministic time period in FIG. **8**H. As shown in FIG. **8**I, the electronic device **120** also detects translational movement **892** of the gaze direction **806** while the XR content **802**A is selected.

[0187] As shown in FIG. **8**J, during the instance **8100** (e.g., associated with time T_{10}) of the content delivery scenario, the electronic device **120** translates the XR content **802** within the XR environment **128** in response to detecting the translational movement **892** of the gaze direction **806** in FIG. **8**I. For example, the directionality and displacement of the translational movement of the XR content **802** within the XR environment **128** corresponds to the spatial parameters of the translational movement **892** of the gaze direction **806** in FIG. **8**I (e.g., change in positional values, change in rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc.).

[0188] FIGS. **8**K-**8**M illustrate a sequence in which XR content is selected in response to detecting a gaze direction directed to the XR content and the XR content is translated based on a hand/extremity tracking input. As shown in FIG. **8**K, during the instance **8110** (e.g., associated with time T_{11}) of the content delivery scenario, the electronic device **120** displays a gaze direction indicator element **852** on the XR content **802** associated with a focal point within the XR environment **128** of the eyes of the user **149** based on eye tracking. For example, the gaze direction indicator element **852** corresponds to a coincidence point between the XR content **802** and rays emanating from the eyes for the user **149**. As shown in FIG. **8**K, the electronic device **120** detects neither the proxy object **804** nor the control device **130** being held by the user **149**.

[0189] As shown in FIG. **8**L, during the instance **8120** (e.g., associated with time T_{12}) of the content delivery scenario, the electronic device **120** changes the appearance of the XR content **802** to a cross-hatching appearance **802**A to visually indicate its selection in response to detecting the gaze direction **806** being directed to the XR content **802** for at least a predetermined or deterministic time period in FIG. **8**K. As shown in FIG. **8**L, the electronic device **120** displays a representation **153** of the right hand **152** of the user **149** nearby the XR content **802**A, which is detected and tracked using hand/extremity tracking. As shown in FIG. **8**L, the electronic device **120** also detects translational movement **8122** of the right hand **152** of the user **149**.

[0190] As shown in FIG. **8**M, during the instance **8130** (e.g., associated with time T_{13}) of the content delivery scenario, the electronic device **120** translates the XR content **802** within the XR environment **128** in response to detecting the translational movement **8122** in FIG. **8**L. For example, the directionality and displacement of the translational movement of the XR content **802** within the XR environment **128** corresponds to the spatial parameters of the translational movement **8122** in FIG. **8**L (e.g., change in positional values, change in rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc.). One of ordinary skill in the art will appreciate that other XR content may be similarly rotated.

[0191] FIGS. **9**A-**9**C illustrate a flowchart representation of a method **900** of selecting an output modality for a physical object when interacting with or manipulating an XR environment in accordance with some implementations. In various implementations, the method **900** is performed at a computing system including non-transitory memory and one or more processors, wherein the computing system is communicatively coupled to a display device and one or more input devices (e.g., the electronic device **120** shown in FIGS. **1** and **3**; the controller **110** in FIGS. **1** and **2**; or a suitable combination thereof). In some implementations, the method **900** is performed by processing logic, including hardware, firmware, software, or a combination thereof. In some implementations, the method **900** is performed by a processor executing code stored in a non-transitory computer-readable medium (e.g., a memory). In some implementations, the computing system corresponds to one of a tablet, a laptop, a mobile phone, a near-eye system, a wearable computing device, or the like.

[0192] Typically, a user switches between marking tools by selecting a new tool from a toolbar or menu. This may interrupt the user's current workflow and may also induce the user to hunt for the new tool within various menus. In contrast, the method described herein enables a user to invoke display of a tool set by swiping on a physical object (e.g., a proxy object, such as a pencil, or an electronic device, such as a stylus) and moving the physical object towards a graphical representation of one of the tools in the tool set. As such, the user is able to switch between tools without interrupting their workflow.

[0193] As represented by block **902**, the method **900** includes displaying, via the display device, a first plurality of graphical elements associated with a first plurality of output modalities within an extended reality (XR) environment. In some implementations, an output modality causes changes within the UI or XR environment such as adding, removing, or otherwise modifying pixels within the UI or XR environment. For example, the first plurality of graphical elements corresponds to different tool types for creating, modifying, etc. marks within the XR environment such as a pencil, a marker, a paint brush, an eraser, etc.

[0194] As one example, the electronic device **120** displays graphical elements **632**A, **632**B, **632**C, and **632**D (sometimes collectively referred to herein as a first plurality of graphical elements **632**) in FIG. **6**C. In this example, the graphical element **632**A corresponds to an output modality associated with generating pencil-like marks within the XR environment **128**, the graphical element **632**B corresponds to an output modality associated with generating pen-like marks within the XR environment **128**, the graphical element **632**C corresponds to an output modality associated with generating marker-like marks within the XR environment **128**, and the graphical element **632**D corresponds to an output modality associated with generating airbrush-like marks within the XR environment **128**. As another example, the electronic device **120** displays graphical elements **6152**A, **6152**B, **6152**C, and **6152**D (sometimes collectively referred to herein as a second plurality of graphical elements **6152**) in FIG. **6**O. In this example, the graphical element **6152**A corresponds to an output modality associated with generating pencil-like marks within the XR environment **128**, the graphical element **6152**B corresponds to an output modality associated with generating pen-like marks within the XR environment **128**, the graphical element **6152**C corresponds to an output modality associated with generating narrow brush-like marks within the XR environment **128**, and the graphical element **6152**D corresponds to an output modality associated with generating wide brush-like marks within the XR environment **128**.

[0195] In some implementations, the display device corresponds to a transparent lens assembly, and wherein the presentation of the XR environment is projected onto the transparent lens assembly. In some implementations, the display device corresponds to a near-eye system, and wherein presenting the XR environment includes compositing the presentation of the XR environment with one or more images of a physical environment captured by an exterior-facing image sensor.

[0196] In some implementations, the method **900** includes: prior to displaying the first plurality of graphical elements, obtaining (e.g., receiving, retrieving, or detecting) an indication of a touch input directed to the physical object, and wherein displaying the first plurality of graphical elements within the XR environment includes displaying the first plurality of graphical elements within the XR environment in response to obtaining the indication of the touch input. In some implementations, the physical object corresponds to a stylus with a touch-sensitive region capable of detecting touch inputs. For example, the stylus detects an upward or downward swipe gesture on its touch-sensitive surface, and the computing system obtains (e.g., receives or retrieves) an indication of the touch input from the stylus. For example, FIGS. **6**B and **6**C illustrate a sequence in which the electronic device **120** displays the first plurality of graphical elements **632** associated with a first plurality of output modalities within the XR environment **128** in FIG. **6**C in response to detecting a touch input **622** directed to the control device **130** in FIG. **6**B.

[0197] In some implementations, the method **900** includes: prior to displaying the first plurality of graphical elements, obtaining (e.g., receiving, retrieving, or determining) a grip pose associated with a current manner in which the physical object is being held by a user, wherein the first plurality of graphical elements is a function of the grip pose; and in response to obtaining the grip pose: in accordance with a determination that the grip pose corresponds to a first grip pose, displaying, via the display device, the first plurality of graphical elements associated with the first plurality of output modalities within the XR environment; and in accordance with a determination that the grip pose corresponds to a second grip pose different from the first grip pose, displaying, via the display device, a second plurality of graphical elements associated with a second plurality of output modalities within the XR environment. For example, a pointing/wand grip corresponds to the first plurality of graphical elements associated with the first plurality of tools, and a writing grip corresponds to a second plurality of graphical elements associated with a second plurality of tools. In some implementations, the first and second pluralities of output modalities include at least one overlapping output modality. In some implementations, the first and second pluralities of output modalities include mutually exclusive output modalities.

[0198] As one example, with reference to FIG. **6**C, the electronic device **120** displays graphical elements **632**

within the XR environment **128** in accordance with a determination that the current grip pose corresponds to a pointing grip pose. As another example, with reference to FIG. **6**O, the electronic device **120** displays graphical elements **6152** within the XR environment **128** in accordance with a determination that the current grip pose corresponds to a writing grip pose with a first end **176** pointed downward and a second end **177** pointed upward. As yet another example, with reference to FIG. **6**P, the electronic device **120** displays graphical elements **6162** within the XR environment **128** in accordance with a determination that the current grip pose corresponds to an inverse writing grip pose with the first end **176** pointed upward and the second end **177** pointed downward.

[0199] In some implementations, the method **900** includes: after displaying the first plurality of graphical elements associated with the first plurality of output modalities within the XR environment, detecting a change in the grip pose from the first grip pose to the second grip pose; and in response to detecting the change in the grip pose, replacing display of the first plurality of graphical elements within the XR environment with the second plurality of graphical elements associated with the second plurality of output modalities within the XR environment. In some implementations, the computing system also ceases to display the first plurality of graphical elements. For example, a pointing/wand grip corresponds to the first plurality of graphical elements associated with the first plurality of output modalities, and a writing grip corresponds to a second plurality of graphical elements associated with a second plurality of output modalities. In some implementations, the first and second pluralities of graphical elements include at least some overlapping output modalities. In some implementations, the first and second pluralities of graphical elements include mutually exclusive output modalities. For example, FIGS. **6**O and **6**P illustrate a sequence in which the electronic device **120** replaces the plurality of graphical elements **6152** with the plurality of graphical elements **6162** in response to detecting a change in the current grip pose of the control device **130** (e.g., from the writing grip pose in FIG. **6**O to the inverse writing grip pose in FIG. **6**P).

[0200] In some implementations, the method **900** includes: prior to displaying the first plurality of graphical elements, obtaining (e.g., receiving, retrieving, or determining) information indicating whether a first end or a second end of the physical object is facing outward (e.g., outward relative to a surface, the user, the computing system, etc.); and in response to obtaining the information indicating whether the first end or the second end of the physical object is facing outward: in accordance with a determination that the first end of the physical object is facing outward, displaying, via the display device, the first plurality of graphical elements associated with the first plurality of output modalities within the XR environment; and in accordance with a determination that the second end of the physical object is facing outward, displaying, via the display device, a second plurality of graphical elements associated with a second plurality of output modalities within the XR environment. For example, a first end facing outwards corresponds to the first plurality of graphical elements associated with the first plurality of output modalities (e.g., sketching and writing tools), and a second end facing outwards corresponds to a second plurality of graphical elements associated with a second plurality of output modalities (e.g., erasing or editing tools). In some implementations, the first and second pluralities of output modalities include at least one overlapping output modality. In some implementations, the first and second pluralities of output modalities include mutually exclusive output modalities.

[0201] As another example, with reference to FIG. **6**O, the electronic device **120** displays graphical elements **6152** within the XR environment **128** in accordance with a determination that the current grip pose corresponds to a writing grip pose with a first end **176** pointed downward and a second end **177** pointed upward. As yet another example, with reference to FIG. **6**P, the electronic device **120** displays graphical elements **6162** within the XR environment **128** in accordance with a determination that the current grip pose corresponds to an inverse writing grip pose with the first end **176** pointed upward and the second end **177** pointed downward.

[0202] In some implementations, the method **900** includes: after displaying the first plurality of graphical elements associated with the first plurality of output modalities within the XR environment, detecting a change from a first end of the physical object facing outward to a second end of the physical object facing outward; and in response to detecting the change from the first end of the physical object facing outward to the second end of the physical object facing outward, displaying, via the display device, the second plurality of graphical elements associated with the second plurality of output modalities within the XR environment. In some implementations, the computing system also ceases to display the first plurality of graphical elements. For example, a first end facing outwards corresponds to the first plurality of graphical elements associated with the first plurality output modalities tools (e.g., sketching and writing tools), and a second end facing outwards corresponds to a second plurality of graphical elements associated with a second plurality of output modalities (e.g., erasing or editing tools). For example, FIGS. **6**O and **6**P illustrate a sequence in which the electronic device **120** replaces display of the plurality of graphical elements **6152** with the plurality of graphical elements **6162** in response to detecting a change in the current grip pose of the control device **130** (e.g., from the writing grip pose in FIG. **6**O to the inverse writing grip pose in FIG. **6**P).

[0203] As represented by block **904**, the method **900** includes detecting first movement of a physical object while displaying the first plurality of graphical elements. In some implementations, the computing system obtains (e.g., receives, retrieves, or determines) translational and rotational values for the physical object, wherein detecting the first movement corresponds to detecting a change to one of the translational or rotational values for the physical object. For example, the computing system tracks the physical object via computer vision, magnetic sensors, positional information, and/or the like. As one example, the physical object corresponds to a proxy object, such as a pencil, a pen, etc., without a communication channel to the computing system. As another example, the physical object corresponds to an electronic device, such as a stylus, finger-wearable device, or the like, with a wired or wireless communication channel to the computing system that includes an IMU, accelerometer, gyroscope, magnetometer, and/or the like for six degrees of freedom (6DOF) tracking.

[0204] In some implementations, the computing system maintains one or more N-tuple tracking vectors/tensors for the physical object (e.g., the object tracking vector **511** in FIGS. **5**A and **5**B) based on tracking data **506**. In some implementations, the one or more N-tuple tracking vectors/tensors for the physical object (e.g., the object tracking vector **511** in FIGS. **5**A and **5**B) include translational values (e.g., x, y, and z) for the physical object relative to the world at large or the current operating environment, rotational values (e.g., roll, pitch, and yaw) for the physical object, a grip pose indication (e.g., pointing, writing, erasing, painting, dictating, etc.) for the physical object, a currently used tip/end indication (e.g., the physical object may have an asymmetrical design with specific first and second tips or a symmetrical design with non-specific first and second tips), a first input (pressure) value associated with how hard the physical object is being pressed against a physical surface, a second input (pressure) value associated with how hard the physical object is being grasped by the user, touch input information, and/or the like.

[0205] In some implementations, the tracking data **506** corresponds to one or more images of the physical environment that include the physical object to enable 6DOF tracking of the physical object via computer vision techniques. In some implementations, the tracking data **506** corresponds to data collected by various integrated sensors of the physical object such as an IMU, accelerometer, gyroscope, magnetometer, etc. For example, the tracking data **506** corresponds to raw sensor data or processed data such as translational values associated with the physical object (relative to the physical environment or the world at large), rotational values associated with the physical object (relative to gravity), a velocity value associated with the physical object, an angular velocity value associated with the physical object, an acceleration value associated with the physical object, an angular acceleration value associated with the physical object, a first input (pressure) value associated with how hard the physical object is contacting a physical surface, a second input (pressure) value associated with how hard the physical object is being grasped by the user, and/or the like.

[0206] In some implementations, the computing system also obtains finger manipulation data detected by the physical object via a communication interface. For example, the finger manipulation data includes touch inputs or gestures directed to a touch-sensitive region of the physical object and/or the like. For example, the finger manipulation data includes contact intensity data relative to the body of the physical object. In some implementations, the physical object includes a touch-sensitive surface/region configured to detect touch inputs directed thereto such as a longitudinally extending touch-sensitive surface. In some implementations, the translational and rotational values for the physical object includes determining translational and rotational values for the physical object based on at least one of IMU data from the physical object, one or more images of a physical environment **105** that include the physical object, magnetic tracking data, and/or the like.

[0207] In some implementations, the computing system further includes a communication interface provided to communicate with the physical object, and wherein obtaining the tracking data **506** associated with the physical object includes obtaining the tracking data **506** from the physical object, wherein the tracking data corresponds to output data from one or more integrated sensors of the physical object. FIGS. **6**C-**6**P illustrate a user **149** grasping a control device **130** that communicates with the electronic device **120** and is used to interact with the XR environment **128**. For example, the one or more integrated sensors includes at least one of an IMU, an accelerometer, a gyroscope, a GPS, a magnetometer, one or more contact intensity sensors, a touch-sensitive surface, and/or the like. In some implementations, the tracking data **506** further indicates whether or not the tip of the physical object contacts a physical surface and a pressure value associated therewith.

[0208] In some implementations, the method **900** includes: obtaining one or more images of a physical environment; recognizing the physical object with the one or more images of the physical environment; and assigning the physical object (e.g., a proxy object) to act as a focus selector when interacting with the XR environment **128**. FIGS. **8**A-**8**D illustrate a user **149** grasping a proxy object **804** (e.g., a ruler, a stick, or the like) that is incapable of communicating with the electronic device **120** and is used to interact with the XR environment **128**. In some implementations, the computing system designates the physical object as the focus selector when the physical object is grasped by the user. In some implementations, the computing system designates the physical object as the focus selector when the physical object is grasped by the user and the physical object satisfies predefined constraints (e.g., a maximum or minimum size, a particular shape, digital rights management (DRM) disqualifiers, etc.). As such, in some implementations, the user **149** may use household objects to interact with the XR environment. In some implementations, the pose and grip indicators may be anchored to the proxy object (or a representation thereof) as the proxy object moves and/or the FOV moves.

[0209] As represented by block **906**, in response to detecting the first movement of the physical object and in accordance with a determination that the first movement of the physical object causes the physical object (e.g., a predetermined portion of the physical object such as a tip of the physical object) to breach a distance threshold relative to a first graphical element among the first plurality of graphical elements, the method **900** includes selecting a first output modality associated with the first graphical element as a current output modality for the physical object. In some implementations, the distance threshold is non-deterministic (i.e., a predetermined X mm radius) or deterministic based on one or more factors such as user preferences, tool usage history, depth of graphical elements relative to the scene, occlusions, current content, current context, etc.

[0210] According to some implementations, the computing system or a component thereof (e.g., the output modality selector **526** in FIG. **5**A) selects a first output modality associated as a current output modality **527** for the physical object in accordance with a determination that the first movement of the physical object causes the physical object to breach a distance threshold relative to a first graphical element among the first plurality of graphical elements. As one example, FIGS. **6**D and **6**E illustrate a sequence in which the electronic device **120** selects a first output modality (e.g., airbrush marking) for the control device **130** in accordance with a determination that a movement of the control device **130** causes the control device **130** (or the representation thereof) to breach the activation region **634** (e.g., the distance threshold) relative to the graphical element **632**D.

[0211] In some implementations, in accordance with a determination that the first movement of the physical object causes the physical object to breach the distance threshold relative to the first graphical element among the first plurality of graphical elements, the method **900** includes: maintaining display of the first graphical element adjacent to the physical object; and ceasing display of a remainder of the first plurality of graphical elements that does not include the first graphical element. As one example, with reference to FIGS. **6**D and **6**E, the electronic device **120** maintains display of the first graphical element (e.g., the graphical element **632**D) among the first plurality of graphical elements (e.g., the graphical elements **632**) overlaid on a tip of the representation **131** of the control device **130** within the XR environment **128** and removes display of the remainder of the first plurality of graphical elements (e.g., the graphical elements **632**A, **632**B, and **632**C) from the XR environment **128**.

[0212] In some implementations, the method **900** includes: after selecting the first output modality associated with the first graphical element as the current output modality for the physical object, detecting second movement of the physical object; and in response to detecting second movement of the physical object, moving the first graphical element based on the second movement of the physical object in order to maintain display of the first graphical element adjacent to the physical object. In some implementations, the first graphical element is anchored to the outward facing end/tip of the physical object. In some implementations, the first graphical element is presented offset from or to the side of the outward facing end/tip of the physical object. In some implementations, the first graphical element "snaps" to a representation of the physical object. As one example, with reference to FIGS. **6**E and **6**F, the electronic device **120** maintains display of the graphical element **632**D overlaid on the tip of the representation **131** of the control device **130** within the XR environment **128** after detecting movement of the control device to perform the marking input **654**.

[0213] In some implementations, the method **900** includes: after ceasing display of the remainder of the first plurality of graphical elements, obtaining (e.g., receiving, retrieving, or detecting) an indication of a touch input directed to the physical object; and in response to obtaining the indication of the touch input, redisplaying, via the display device the first plurality of graphical elements within the XR environment. In some implementations, the physical object corresponds to a stylus with a touch-sensitive region capable of detecting touch inputs. For example, the stylus detects an upward or downward swipe gesture on its touch-sensitive surface, and the computing system obtains (e.g., receives or retrieves) an indication of the touch input from the stylus. As one example, with reference to FIGS. **6**N and **6**O, the electronic device **120** displays a second plurality of graphical elements **6152** associated with a second plurality of output modalities within the XR environment **128** in response to detecting a touch input **6142** directed to the control device **130**.

[0214] As represented by block **908**, in response to detecting the first movement of the physical object and in accordance with a determination that the first movement of the physical object causes the physical object to breach the distance threshold relative to a second graphical element among the first plurality of graphical elements, the method **900** includes selecting a second output modality associated with the second graphical element as the current output modality for the physical object.

[0215] According to some implementations, the computing system or a component thereof (e.g., the output modality selector **526** in FIG. **5**A) selects a second output modality associated as a current output modality **527** for the physical object in accordance with a determination that the first movement of the physical object causes the physical object to breach a distance threshold relative to a second graphical element among the first plurality of graphical elements. As one example, FIGS. **6**G-**6**I illustrate a sequence in which the electronic device **120** selects a second output modality (e.g., pen marking) for the control device **130** in accordance with a determination that a movement of the control device **130** causes the control device **130** (or the representation thereof) to breach the activation region **634** (e.g., the distance threshold) relative to the graphical element **632**B.

[0216] In some implementations, in accordance with the determination that the first movement of the physical object causes the physical object to breach the distance threshold relative to the second graphical element among the first plurality of graphical elements, the method **900** includes: maintaining display of the second graphical element adjacent to the physical object; and ceasing display of a remainder of the first plurality of graphical elements that does not include the second graphical element. As one example, with reference to FIGS. **6**H and **6**I, the electronic device **120** maintains display of the second graphical element (e.g., the graphical element **632**B) among the first plurality of graphical elements (e.g., the graphical elements **632**) overlaid on a tip of the representation **131** of the control device **130** within the XR environment **128** and removes display of the remainder of the first plurality of graphical elements (e.g., the graphical elements **632**A, **632**C, and **632**D) from the XR environment **128**.

[0217] In some implementations, as represented by block **910**, the first and second output modalities cause different visual changes within the XR environment. For example, the first output modality is associated with selecting/manipulating object/content within the XR environment, and the second output modality is associated with sketching, drawing, writing, etc. within the XR environment. As one example, with reference to FIG. **6**F, the electronic device **120** displays an airbrush-like mark **662** within the XR environment **128** in response to detecting the marking input **654** in FIG. **6**E while the current output modality corresponds to the graphical element **632**D. As another example, with reference to FIG. **6**J, the electronic device **120** displays a pen-like mark **6112** within the XR environment **128** in response to detecting the marking input **6104** in FIG. **6**J while the current output modality corresponds to the graphical element **632**B.

[0218] In some implementations, in accordance with a determination that the first movement of the physical object does not cause the physical object to breach the distance threshold relative to the first graphical element or the second graphical element, the method **900** includes: maintaining an initial output modality as the current output modality for the physical object; and maintaining display of the first plurality of graphical elements. As one example, with reference to

FIG. **6**C, the electronic device **120** maintains the initial output modality as the current output modality for the control device **130** while the representation **131** of the control device **130** is outside of the activation region **634**. As another example, with reference to FIG. **6**G, the electronic device **120** maintains the initial output modality as the current output modality for the control device **130** while the representation **131** of the control device **130** is outside of the activation region **634**.

[0219] In some implementations, as represented by block **912**, the method **900** includes: after selecting the first output modality associated with the first graphical element as the current output modality for the physical object, detecting a subsequent marking input with the physical object; and in response to detecting the subsequent marking input, displaying, via the display device, one or more marks within the XR environment based on the subsequent marking input (e.g., the shape, displacement, etc. of the subsequent marking input) and the first output modality. According to some implementations, the computing system detects the subsequent marking input with the physical object by tracking the physical object in 3D with IMU data, computer vision, magnetic tracking, and/or the like. In some implementations, the one or more marks corresponds to XR content displayed within the XR environment **128** such as a sketch, handwritten text, a doodle, or the like. As one example, with reference to FIG. **6**F, the electronic device **120** displays an airbrush-like mark **662** within the XR environment **128** in response to detecting the marking input **654** in FIG. **6**E while the current output modality corresponds to the graphical element **632**D. For example, the shape, depth, length, angle, etc. of the airbrush-like mark **662** corresponds to the spatial parameters of the marking input **654** (e.g., positional values, rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc. associated with the marking input).

[0220] In some implementations, as represented by block **914**, in response to detecting the subsequent marking input, the method **900** includes: in accordance with a determination that an input associated with how hard the physical object is being pressed against a physical surface corresponds to a first input value, displaying, via the display device, one or more marks with a first appearance within the XR environment based on the subsequent marking input (e.g., the shape, displacement, etc. of the subsequent marking input) and the first output modality, wherein the first appearance is associated with a parameter of the one or more marks that corresponds to the first input value; and in accordance with a determination that the input associated with how hard the physical object is being pressed against a physical surface corresponds to a second input value, displaying, via the display device, one or more marks with a second appearance within the XR environment based on the subsequent marking input (e.g., the shape, displacement, etc. of the subsequent marking input) and the first output modality, wherein the second appearance is associated with the parameter of the one or more marks that corresponds to the second input value.

[0221] In some implementations, the one or more marks correspond to XR content displayed within the XR environment **128** such as a sketch, handwritten text, a doodle, or the like. In some implementations, the computing system obtains (e.g., receives, retrieves, or determines) the first and second input (pressure) values based on locally or remotely collected data. As one example, the physical object corresponds to an electronic device with pressure sensors in one or both of its ends/tips to detect an input (pressure) value when pressed against the physical surface. In some implementations, as represented by block **916**, the parameter corresponds to one of a radius, width, thickness, intensity, translucency, opacity, color, or texture of the one or more marks within the XR environment.

[0222] In one example, with reference to FIG. **7**H, the electronic device **120** displays a mark **782**A on the XR substrate **718** within the XR environment **128** and a mark **782**B on the input region **774** in response to detecting the marking input **715** in FIG. **7**G. For example, the shape, depth, length, angle, etc. of the marks **782**A and **782**B corresponds to the spatial parameters of the marking input **772** in FIG. **7**G (e.g., positional values, rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc. associated with the marking input). Furthermore, in FIG. **7**H, the marks **782**A and **782**B are associated with a first thickness value, which corresponds to the current measurement **779** of the input (pressure) value in FIG. **7**G.

[0223] In another example, with reference to FIG. **7**J, the electronic device **120** displays a mark **7102**A on the XR substrate **718** within the XR environment **128** and a mark **7102**B on the input region **774** in response to detecting the marking input **792** in FIG. **7**I. For example, the shape, depth, length, angle, etc. of the marks **7102**A and **7102**B corresponds to the spatial parameters of the marking input **792** in FIG. **7**I (e.g., positional values, rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc. associated with the marking input). Furthermore, in FIG. **7**J, the marks **7102**A and **7102**B are associated with a second thickness value, which corresponds to the current measurement **799** of the input (pressure) value in FIG. **7**I. For example, the second thickness value associated with the marks **7102**A and **7102**B is greater than the first thickness value associated with the marks **782**A and **782**B.

[0224] In some implementations, as represented by block **918**, in response to detecting the subsequent marking input, the method **900** includes: in accordance with a determination that an input associated with how hard the physical object is being grasped by the user corresponds to a first input value, displaying, via the display device, one or more marks with a first appearance within the XR environment based on the subsequent marking input (e.g., the shape, displacement, etc. of the subsequent marking input) and the first output modality, wherein the first appearance is associated with a parameter of the one or more marks that corresponds to the first input value; and in accordance with a determination that the input associated with how hard the physical object is being grasped by the user corresponds to a second input value, displaying, via the display device, one or more marks with a second appearance within the XR environment based on the subsequent marking input (e.g., the shape, displacement, etc. of the subsequent marking input) and the first output modality, wherein the second appearance is associated with the parameter of the one or more marks that corresponds to the second input value.

[0225] In some implementations, the one or more marks correspond to XR content displayed within the XR environment **128** such as a sketch, handwritten text, a doodle, or the like. In some implementations, the computing system obtains (e.g., receives, retrieves, or determines) the first and second input (pressure) values based on locally or remotely collected data. As one example, the physical object corresponds to an electronic device with built-in pressure sensors to detect an input (pressure) value when grasped by the user. In some implementations, as represented by block **920**, the parameter corresponds to one of a radius, width, thickness, intensity, translucency, opacity, color, or texture of the mark within the XR environment.

[0226] In one example, with reference to FIG. **6**J, the electronic device **120** displays a pen-like mark **6112** within the XR environment **128** in response to detecting the marking input **6104** in FIG. **6**J while the current output modality corresponds to the graphical element **632**B. For example, the shape, depth, length, angle, etc. of the pen-like mark **6112** corresponds to the spatial parameters of the marking input **6104**. Furthermore, in FIG. **6**K, the pen-like mark **6112** is associated with a first thickness value, which corresponds to the current measurement **6103** of the input (pressure) value in FIGS. **6**J.

[0227] In another example, with reference to FIG. **6**M, the electronic device **120** displays a pen-like mark **6132** within the XR environment **128** in response to detecting the marking input **6122** in FIG. **6**L. For example, the shape, depth, length, angle, etc. of the pen-like mark **6132** corresponds to the spatial parameters of the marking input **6122**. Furthermore, in FIG. **6**M, the pen-like mark **6132** is associated with a second thickness value, which corresponds to the current measurement **6123** of the input (pressure) value in FIGS. **6**L. The second thickness value associated with the pen-like mark **6132** in FIG. **6**M is greater than the first thickness value associated with the pen-like mark **6112** in FIG. **6**K.

[0228] FIGS. **10**A and **10**B illustrate a flowchart representation of a method **1000** of changing a parameter of a mark based on a first input (pressure) value while marking directly on a physical surface or based on a second input (pressure) value while marking indirectly in accordance with some implementations. In various implementations, the method **1000** is performed at a computing system including non-transitory memory and one or more processors, wherein the computing system is communicatively coupled to a display device and one or more input devices (e.g., the electronic device **120** shown in FIGS. **1** and **3**; the controller **110** in FIGS. **1** and **2**; or a suitable combination thereof). In some implementations, the method **1000** is performed by processing logic, including hardware, firmware, software, or a combination thereof. In some implementations, the method **1000** is performed by a processor executing code stored in anon-transitory computer-readable medium (e.g., a memory). In some implementations, the computing system corresponds to one of a tablet, a laptop, a mobile phone, a near-eye system, a wearable computing device, or the like.

[0229] Typically, a user may adjust a marking parameter, such as line thickness, by moving a slider or the like in a toolbar or control panel. This may interrupt the user's current workflow and may also induce the user to hunt within various menus for the appropriate control. In contrast, the method described herein adjusts a marking parameter based on a first input (pressure) value between a physical object (e.g., a proxy object or a stylus) and a physical surface when the marking input is directed to the physical surface or based on a second input (pressure) value associated with a user's grasp of the physical object. As such, the user is able to adjust the marking parameter with greater speed and efficiency.

[0230] As represented by block **1002**, the method **1000** includes displaying, via the display device, a user interface. In some implementations, the user interface includes (**1004**) a two-dimensional marking region on which the mark is displayed. (e.g., a planar canvas) In some implementations, the user interface includes (**1006**) a three-dimensional marking region within which the mark is displayed (e.g., the mark is associated with a 3D painting or drawing). As one example, with reference to FIG. **7**A, the electronic device **120** presents the XR environment **128** including an XR substrate **718** (e.g., a 2D or a 3D canvas).

[0231] In some implementations, the display device corresponds to a transparent lens assembly, and wherein the presentation of the user interface is projected onto the transparent lens assembly. In some implementations, the display device corresponds to a near-eye system, and wherein presenting the user interface includes compositing the presentation of the user interface with one or more images of a physical environment captured by an exterior-facing image sensor.

[0232] In some implementations, the method **1000** includes displaying, via the display device, a user interface element (e.g., a toolbar, menu, etc.) with a plurality of different selectable tools associated with marking within a user interface. In some implementations, the user interface element is anchored to a point in space. For example, the user interface element may be moved to a new anchor point in space. In some implementations, when the user turns his/her head, the user interface element will remain anchored to the point in space and may leave the field-of-view until the user completes a reverse head turn motion (e.g., world/object-locked). In some implementations, the user interface element is anchored to a point within a field-of-view of a user of the computing system (e.g., head/body-locked). For example, the user interface element may be moved to a new anchor point in the FOV. In some implementations, when the user turns his/her head, the user interface element will remain anchored to the point in the FOV such that the toolbar stays within the FOV.

[0233] As one example, with reference to FIG. **7**A, the electronic device **120** presents the XR environment **128** including a menu **712**. As shown in FIG. **7**A, the menu **712** includes a plurality of selectable options **714** associated with changing the appearance of marks made within the XR environment (e.g., different colors, textures, etc.). For example, option **714**A is currently selected among the plurality of selectable options **714**. In this example, the option **714**A corresponds to a first appearance for marks made within the XR environment **128** (e.g., black marks). As shown in FIG. **7**A, the menu **712** also includes a slider **716** for adjusting the thickness of marks made within the XR environment **128**.

[0234] As represented by block **1008**, while displaying the user interface, the method **1000** includes detecting a marking input with a physical object. For example, the marking input corresponds to creation of 2D or 3D XR content such as a sketch, handwritten text, a doodle, and/or the like. In some implementations, the computing system obtains (e.g., receives, retrieves, or determines) translational and rotational values for the physical object, wherein detecting the first movement corresponds to detecting a change to one of the translational or rotational values for the physical object. For example, the computing system tracks the physical object via computer vision, magnetic sensors, and/or the like. As one example, the physical object corresponds to a proxy object, such as a pencil, a pen, etc., without a communication channel to the computing system. As another example, the physical object corresponds to an electronic device, such as a stylus, finger-wearable device, or the like, with a wired or wireless communication channel to the computing system that includes an IMU, accelerometer, gyroscope, and/or the like for 6DOF tracking.

[0235] In some implementations, the computing system maintains one or more N-tuple tracking vectors/tensors for the physical object (e.g., the object tracking vector **511** in FIGS. **5**A and **5**B) including translational values (e.g., x, y, and z) relative to the world at large or the current operating environment, rotational values (e.g., roll, pitch, and yaw), a grip pose indication (e.g., pointing, writing, erasing, painting, dictating, etc.), a currently used tip/end indication (e.g., the physical object may have an asymmetrical design with specific first and second tips or a symmetrical design with non-specific first and second tips), a first input (pressure) value associated with how hard the physical object is being pressed against a physical surface, a second input (pressure) value associated with how hard the physical object is being grasped by the user, and/or the like.

[0236] In some implementations, the physical object includes a touch-sensitive surface/region configured to detect touch inputs directed thereto such as a longitudinally extending touch-sensitive surface. In some implementations, obtaining the translational and rotational values for the physical object includes determining translational and rotational values for the physical object based on at least one of inertial measurement unit (IMU) data from the physical object, one or more images of a physical environment that include the physical object, magnetic tracking data, and/or the like.

[0237] As represented by block **1010**, in response to detecting the marking input and in accordance with a determination that the marking input is directed to a physical surface (e.g., a tabletop, another planar surface, or the like), the method **1000** includes displaying, via the display device, a mark within the user interface based on the marking input (e.g., the shape, size, orientation , etc. of the marking input), wherein a parameter of the mark displayed based on the marking input is determined based on how hard the physical object is being pressed against the physical surface. In some implementations, the computing system or a component thereof (e.g., the parameter adjustor **528** in FIG. **5**A) adjusts an output parameter associated with a detected marking input directed to the XR environment **128** (e.g., the thickness, brightness, color, texture, etc. of marks) based on how hard the physical object is being pressed against the physical surface (e.g., the first input (pressure) value) in accordance with a determination that the marking input is directed to a physical surface (e.g., a tabletop, another planar surface, or the like). In some implementations, the parameter corresponds to (**1014**) one of a radius, width, thickness, intensity, translucency, opacity, color, or texture of the mark within the user interface.

[0238] According to some implementations, the parameter of the mark is determined based on how hard a predefined portion of the physical object such as a tip of the physical object that is in contact with a physical surface in the three-dimensional environment is being pressed up against the physical surface. As one example, the physical object corresponds to an electronic device with pressure sensors in one or both of its ends/tips to detect a first input (pressure) value when pressed against the physical surface. In some implementations, the computing system maps the marking input on the physical surface to a 3D marking region or a 2D canvas within an XR environment. For example, the marking region and the physical surface correspond to perpendicular planes that are offset by Y cm.

[0239] As one example, FIGS. **7**G and **7**H illustrate a sequence in which detection of a marking input **772** causes the marks **782**A and **782**B to be displayed within the XR environment **128** according to the measurement **779** of the input (pressure) value. For example, the shape, depth, length, angle, etc. of the marks **782**A and **782**B corresponds to the spatial parameters of the marking input **772** in FIG. **7**G (e.g., positional values, rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc. associated with the marking input). Furthermore, in FIG. **7**H, the marks **782**A and **782**B are associated with a first thickness value, which corresponds to the measurement **779** of the input (pressure) value in FIG. **7**G.

[0240] As another example, FIGS. **7**I and **7**J illustrate a sequence in which detection of a marking input **792** causes the marks **7102**A and **7102**B to be displayed within the XR environment **128** according to the measurement **799** of the input (pressure) value. For example, the shape, depth, length, angle, etc. of the marks **7102**A and **7102**B corresponds to the spatial parameters of the marking input **792** in FIG. **7**I (e.g., positional values, rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc. associated with the marking input). Furthermore, in FIG. **7**J, the marks **7102**A and **7102**B are associated with a second thickness value, which corresponds to the current measurement **799** of the input (pressure) value in FIGS. **7**I. For example, the second thickness value associated with the marks **7102**A and **7102**B is greater than the first thickness value associated with the marks **782**A and **782**B.

[0241] As represented by block **1012**, in response to detecting the marking input and in accordance with a determination that the marking input is not directed to the physical surface, the method **1000** includes displaying, via the display device, the mark within the user interface based on the marking input (e.g., the shape, size, orientation , etc. of the marking input), wherein a parameter of the mark displayed based on the marking input is determined based on how hard the physical object is being grasped by the user. In some implementations, the computing system or a component thereof (e.g., the parameter adjustor **528** in FIG. **5**A) adjusts an output parameter associated with a detected marking input directed to the XR environment **128** (e.g., the thickness, brightness, color, texture, etc. of marks) based on how hard the physical object is being grasped by the user **149** (e.g., the second input (pressure) value) in accordance with a determination that the marking input is not directed to a physical surface. In some implementations, the parameter corresponds to (**1014**) one of a radius, width, thickness, intensity, translucency, opacity, color, or texture of the mark within the user interface.

[0242] According to some implementations, the computing system detects the marking input while the physical object or a predefined portion of the physical object such as a tip of the physical object is not in contact with any physical surface in the three-dimensional environment. For example, the physical object corresponds to an electronic device with built-in pressure sensors to detect a second input (pressure) value when grasped by the user.

[0243] As one example, FIGS. **7**A and **7**B illustrate a sequence in which detection of a marking input **715** causes the mark **722** to be displayed within the XR environment **128** according to the current measurement **719** of the input (pressure) value. For example, the shape, depth, length, angle, etc. of the mark **722** corresponds to the spatial parameters of the marking input **715** (e.g., positional values, rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc. associated with the marking input). Furthermore, in FIG. **7**B, the mark **722** is associated with a first thickness value, which corresponds to the current measurement **719** of the input (pressure) value in FIG. **7**A.

[0244] As another example, FIGS. **7**C and **7**D illustrate a sequence in which detection of a marking input **732** causes the mark **742** to be displayed within the XR environment **128** according to the measurement **739** of the input (pressure) value. For example, the shape, depth, length, angle, etc. of the mark **742** corresponds to the spatial parameters of the marking input **732**. Furthermore, in FIG. **7**D, the mark **742** is associated with a second thickness value, which corresponds to the current measurement **739** of the input (pressure) value in FIG. **7**C. For example, the second thickness value associated with the mark **742** is greater than the first thickness value associated with the mark **722**.

[0245] In some implementations, as represented by block **1016**, the method **1000** includes: after displaying the mark within the user interface, detecting a subsequent input with the physical object associated with moving (e.g., translating and/or rotating) the mark within the user interface; and in response to detecting the subsequent input, moving the mark within the user interface based on the subsequent input. As one example, FIGS. **7**E and **7**F illustrate a sequence in which the electronic device translates the mark **742** within the XR environment **128** in response to detecting the manipulation input **752**. For example, the angle, directionality, displacement, etc. of the translational movement of the mark **742** corresponds to the spatial parameters of the manipulation input **752** in FIG. **7**E. In some implementations, the manipulation input **752** may also cause rotational movement of the mark **742** based on rotational parameters of the manipulation input **752**.

[0246] In some implementations, as represented by block **1018**, detecting the subsequent input corresponds to obtaining an indication that an affordance on the physical object has been actuated; and detecting at least one of rotational or translational movement of the physical object. For example, actuation of the affordance corresponds to detection of a touch input directed to the touch-sensitive surface of the control device **130**. As one example, FIGS. **7**E and **7**F illustrate a sequence in which the electronic device **120** translates the mark **742** within the XR environment **128** in response to detecting the manipulation input **752** while also detecting the touch input **754** directed to the touch-sensitive surface **175** of the control device **130** in FIG. **7**E.

[0247] In some implementations, as represented by block **1020**, detecting the subsequent input corresponds to obtaining an indication that an input value associated with how hard the physical object is being grasped by the user exceeds a threshold input value; and detecting at least one of rotational or translational movement of the physical object. For example, the input (pressure) value corresponds to a selection portion of the subsequent input. In some implementations, the pressure threshold is non-deterministic (i.e., a predetermined pressure value) or deterministic based on one or more factors such as user preferences, usage history, current content, current context, etc.

[0248] In some implementations, as represented by block **1022**, in response to detecting the subsequent input, the method **1000** includes changing an appearance of at least some content within the user interface while moving the mark within the user interface. For example, the computing system increases the opacity, translucency, blur radius, etc. of at least some content such as the 2D canvas or 3D marking region.

[0249] In some implementations, as represented by block **1024**, in response to detecting the marking input and in accordance with a determination that the marking input is directed to the physical surface, the method **1000** includes displaying, via the display device, a simulated shadow within the XR environment that corresponds to a distance between the physical surface and the physical object. In some implementations, a size, angle, etc. of the shadow changes as the physical object gets closer to or further away from the physical surface. As one example, a size of the simulated shadow increases and an associated opacity value decreases as the physical object moves farther away from the physical surface. Continuing with this example, the size of the simulated shadow decreases and the associated opacity value increases as the physical object moves closer to the physical surface. In some implementations, a shadow may also be shown when the marking input is not directed to the physical surface.

[0250] As one example, FIGS. **7**K and **7**L illustrate a sequence in which the electronic device **120** displays the first XR content **7122** within the XR environment **128** according to the current measurement **7119** of the input (pressure) value in response to detecting the first content placement input associated with the touch input **7111**. As shown in FIG. **7**L, the electronic device **120** also displays a shadow **7124** on the XR substrate **7118** associated with the first XR content **7122**. For example, the positional and rotational values of the first XR content **7122** and the shadow **7124** correspond to the parameters of the representation **131** of the control device **130** (e.g., positional values, rotational values, etc.) when the touch input **7111** was detected in FIG. **7**K. For example, the first XR content **7122** is associated with a first size value, which corresponds to the current measurement **7119** of the input (pressure) value in FIG. **7**K.

[0251] As another example, FIGS. **7**M and **7**N illustrate a sequence in which the electronic device **120** displays the second XR content **7142** within the XR environment **128** according to the measurement **7139** of the input (pressure) value in response to detecting the second content placement input associated with the touch input **7131**. As shown in FIG. **7**N, the electronic device **120** does not display a shadow associated with the second XR content **7142** on the XR substrate **7118**. For example, the positional and rotational values of the second XR content **7142** correspond to the parameters of the representation **131** of the control device **130** (e.g., positional values, rotational values, etc.) when the touch input **7131** was detected in FIG. **7**M. For example, the second XR content **7142** is associated with a second size value, which corresponds to the current measurement **7139** of the input (pressure) value in FIG. **7**K. For example, the second size value associated with the second XR content **7142** is greater than the first size value associated with the first XR content **7122**.

[0252] FIG. **11** is a flowchart representation of a method **1100** of changing a selection modality based on whether a user is currently grasping a physical object in accordance with some implementations. In various implementations, the method **1100** is performed at a computing system including non-transitory memory and one or more processors, wherein the computing system is communicatively coupled to a display device and one or more input devices (e.g., the electronic device **120** shown in FIGS. **1** and **3**; the controller **110** in FIGS. **1** and **2**; or a suitable combination thereof). In some implementations, the method **1100** is performed by processing logic, including hardware, firmware, software, or a combination thereof. In some implementations, the method **1100** is performed by a processor executing code stored in a non-transitory computer-readable medium (e.g., a memory). In some implementations, the computing system corresponds to one of a tablet, a laptop, a mobile phone, a near-eye system, a wearable computing device, or the like.

[0253] Typically, a user is limited to one or more input modalities, such as touch inputs, voice commands, etc., when navigating content within a user interface. Furthermore, the one or more input modalities may be applicable regardless of the current context, such as while operating a vehicle, while in-motion, while hands are full, etc., which may prompt usability and safety concerns. In contrast, the method described herein enables a user to select content based on gaze direction when not holding a physical object (e.g., a proxy object or a stylus) with a pointing grip and also enables a user to select content based on the direction of the physical object when holding the physical object with the pointing grip. As such, the input modality for selecting content dynamically changes based on the current context.

[0254] As represented by block **1102**, the method **1100** includes displaying, via the display device, content. As one example, the content corresponds to volumetric or 3D content within an XR environment. As another example, the content corresponds to flat or 2D content within a user interface (UI). For example, with reference to FIGS. **8**A-**8**D, the electronic device **120** displays a VA **606** and XR content **802** within the XR environment **128**.

[0255] In some implementations, the display device corresponds to a transparent lens assembly, and wherein the presentation of the content is projected onto the transparent lens assembly. In some implementations, the display device corresponds to a near-eye system, and wherein presenting the content includes compositing the presentation of the content with one or more images of a physical environment captured by an exterior-facing image sensor.

[0256] As represented by block **1104**, while displaying the content, and while a physical object is being held by a user, the method **1100** includes detecting a selection input. As one example, the physical object corresponds to a proxy object detected within the physical environment that lacks a communication channel to the computing system such as a pencil, a pen, etc. With reference to FIGS. **8**A-**8**D, the electronic device **120** displays a representation **153** of the right hand **152** of the user **149** gripping a representation **805** of a proxy object **804** (e.g., a stick, a ruler, or another physical object) within the XR environment **128**. For example, the right hand **152** of the user **149** is currently gripping the proxy object **804** with a pointing grip pose. As another example, the physical object corresponds to an electronic device with a wired or wireless communication channel to the computing system such as a stylus, a finger-wearable device, a handheld device, or the like. With reference to FIGS. **8**E-**8**G, the electronic device **120** displays a representation **153** of the right hand **152** of the user **149** gripping a representation **131** of a control device **130** within the XR environment **128**. For example, the right hand **152** of the user **149** is currently gripping the control device **130** with a writing grip pose that is not pointed at any XR content within the XR environment **128**.

[0257] As represented by block **1106**, in response to detecting the selection input, the method **1100** includes performing an operation corresponding to the selection input. In some implementations, the computing system or a component thereof (e.g., the content selection engine **522** in FIG. **5**A) determines a selected content portion **523** based on the characterization vector **531** (or a portion thereof). For example, the content selection engine **522** determines the selected content portion **523** based on the current contextual information, the gaze direction of the user **149**, body pose information associated with the user **149**, head pose information associated with the user **149**, hand/extremity tracking information associated with the user **149**, positional information associated with the physical object, rotational information associated with the physical object, and/or the like.

[0258] As one example, the content selection engine **522** performs a selection operation on a first portion of content based on a direction in which (e.g., a ray projecting from) a predetermined portion (e.g., an outward facing end) of the physical object is pointing in accordance with a determination that a grip pose, associated with a manner in which the physical object is being held by the user, corresponds to a first grip (e.g., the first grip=a pointing/wand-like grip). As another example, the content selection engine **522** performs a selection operation on a second portion of the content based on a gaze direction of the user in accordance with a determination that the grip pose, associated with the manner in which the physical object is being held by the user, does not correspond to the first grip.

[0259] In some implementations, as represented by block **1108**, the method **1100** includes changing an appearance of the first or second portions of the content. As one example, changing the appearance of the first or second portions of the content corresponds to changing a color, texture, brightness, etc. of the first or second portions of the content to indicate that it has been selected. As another example, changing the appearance of the first or second portions of the content corresponds to displaying a bounding box, highlighting, spotlight, and/or the like in association with the first or second portions of the content to indicate that it has been selected. For example, with reference to FIG. **8**C, the electronic device **120** changes the appearance of the XR content **802** to a cross-hatching appearance **802**A to visually indicate its selection in response to detecting the proxy object **804** being pointed at the XR content **802** for at least a predetermined or deterministic time period in FIGS. **8**A and **8**B. For example, with reference to FIG. **6**D, the electronic device **120** changes the appearance of the graphical element **632**D by displaying a border or frame **642** around the graphical element **632**D to indicate its selection in response to detecting movement of the control device **130** that causes the spatial location of the representation **131** of the control device **130** to breach the activation region **634** relative to the graphical element **632**D.

[0260] As represented by block **1110**, in accordance with a determination that a grip pose, associated with a manner in which the physical object is being held by the user, corresponds to a first grip (e.g., the first grip=a pointing/wand-like grip), the method **1100** includes performing a selection operation on a first portion of the content, wherein the first portion of the content is selected based on a direction in which (e.g., a ray projecting from) a predetermined portion (e.g., an outward facing end) of the physical object is pointing (e.g., without regard to a direction of gaze of the user). In some implementations, the computing system or a component thereof (e.g., the content selection engine **522** in FIG. **5**A) performs a selection operation on a first portion of content based on a direction in which (e.g., a ray projecting from) a predetermined portion (e.g., an outward facing end) of the physical object is pointing in accordance with a determination that a grip pose, associated with a manner in which the physical object is being held by the user, corresponds to a first grip (e.g., the first grip=a pointing/wand-like grip). As one example, FIGS. **8**B and **8**C illustrate a sequence in which the electronic device **120** selects the XR content **802** in response to detecting a proxy object **804** (or the representation **805** thereof) being pointed at the XR content **802** for at least a predetermined or deterministic time period and in accordance with the determination that the grip pose, associated with the manner in which the physical object **804** is being held by the user **149**, corresponds to the first grip (e.g., a pointing grip).

[0261] In some implementations, the computing system obtains (e.g., receives, retrieves, or determines) translational and rotational values for the physical object and obtains (e.g., receives, retrieves, or determines) grip pose associated with the current manner in which the physical object is being held by the user. For example, the computing system tracks the physical object via computer vision, magnetic sensors, and/or the like. As one example, the physical object corresponds to a proxy object, such as a pencil, a pen, etc., without a communication channel to the computing system. As another example, the physical object corresponds to an electronic device, such as a stylus, finger-wearable device, or the like, with a wired or wireless communication channel to the computing system that includes an IMU, accelerometer, gyroscope, and/or the like for 6DOF tracking. In some implementations, the computing system maintains one or more N-tuple tracking vectors/tensors for the physical object including translational values (e.g., x, y, and z) relative to the world at large or the current operating environment, rotational values (e.g., roll, pitch, and yaw), a grip pose indication (e.g., pointing, writing, erasing, painting, dictating, etc. pose), a currently used tip/end indication (e.g., the physical object may have an asymmetrical design with specific first and second tips or a symmetrical design with non-specific first and second tips), a first input (pressure) value associated with how hard the physical object is being pressed against a physical surface, a second input (pressure) value associated with how hard the physical object is being grasped by the user, and/or the like. In some implementations, the physical object includes a touch-sensitive surface/region configured to detect touch inputs directed thereto such as a longitudinally extending touch-sensitive surface. In some implementations, obtaining the translational and rotational values for the physical object includes determining translational and rotational values for the physical object based on at least one of IMU data from the physical object, one or more images of a physical environment that include the physical object, magnetic tracking data, and/or the like.

[0262] As represented by block **1112**, in accordance with a determination that the grip pose, associated with the manner in which the physical object is being held by the user, does not correspond to the first grip, the method **1100** includes performing the selection operation on a second portion of the content that is different from the first portion of the content, wherein the second portion of the content is selected based on a gaze direction of the user (e.g., without regard to a direction of a ray projecting from the predetermined portion of the physical object). In some implementations, the computing system or a component thereof (e.g., the eye tracking engine **512** in FIG. **5**A) determines and updates an eye tracking vector **513** that includes x and y coordinates associated with a gaze direction relative to the world at large or the current operating environment, a focal length or a focal point, and/or the like. In some implementations, the computing system determines the eye tracking vector **513** based on one or more images of the eye(s) of the user from interior-facing image sensors. In some implementations, the computing system determines a region of interest (ROI) within the XR environment **128** based on the gaze direction (e.g., an N×M mm ROI).

[0263] In some implementations, the computing system or a component thereof (e.g., the content selection engine **522** in FIG. **5**A) performs a selection operation on a second portion of the content based on a gaze direction of the user in accordance with a determination that the grip pose, associated with the manner in which the physical object is being held by the user, does not correspond to the first grip. As one example, FIGS. **8**E and **8**F illustrate a sequence in which the electronic device **120** selects the XR content **802** in response to detecting a gaze direction **806** of the user **149** being directed to the XR content **802** for at least the predetermined or deterministic time period and in accordance with the determination that the grip pose, associated with the manner in which the physical object **130** is being held by the user **149**, does not correspond to the first grip.

[0264] In some implementations, as represented by block **1114**, in accordance with the determination that the grip pose corresponds to the first grip, the method **1100** includes displaying, via the display device, a first graphical element indicating the direction the predetermined portion of the physical object is pointing relative to the content. For example, the first graphical element is displayed at a coincidence point at which a ray projected from the predetermined portion of the physical object coincides with content, the 2D canvas, the 3D marking region, a backplane, and/or the like within the XR environment **128**. As one example, with reference to FIG. **8**A, the electronic device **120** displays the first indicator element **812**A with a first size on the XR content **802** that corresponds to a coincidence point between the XR content **802** and a ray emanating from a tip/end of the representation **805** of the proxy object

[0265] In some implementations, a size parameter (e.g., radius) of the first graphical element is (**1116**) a function of a distance between the first portion of the content and the physical object. In some implementations, the size of the first indicator element increases as the distance between the first portion of the content and the physical object the decreases, and the size of the first indicator element decreases as the distance between the first portion of the content and the physical object increases. As one example, with reference to FIG. **8**A, the electronic device **120** displays the first indicator element **812**A with a first size on the XR content **802** that corresponds to a coincidence point between the XR content **802** and a ray emanating from a tip/end of the representation **805** of the proxy object **804**. In this example, a size of the first indicator element **812**A is a function of the first distance **814**. As another example, with reference to FIG. **8**B, the electronic device **120** displays a second indicator element **812**B with a second size on the XR content **802** that corresponds to a coincidence point between the XR content **802** and a ray emanating from the tip/end of the representation **805** of the proxy object **804**. As shown in FIG. **8**B, the representation **805** of the proxy object **804** is a second distance **824** from the XR content **802**, which is less than the first distance **814** in FIG. **8**A. For example, the second size of the second indicator element **812**B is greater than the first size of the first indicator element **812**A.

[0266] In some implementations, as represented by block **1118**, in accordance with the determination that the grip pose does not correspond to the first grip, the method **1100** includes displaying, via the display device, a second graphical element indicating the gaze direction of the user relative to the content. For example, the second graphical element is different from the first graphical element. For example, the second graphical element is displayed at a coincidence point at which a ray projected from the one or more eyes of the user strikes content, the 2D canvas, the 3D marking region, a backplane, and/or the like within the XR environment. For example, with reference to FIG. **8**E, the electronic device **120** displays a gaze direction indicator element **852** on the XR content **802** associated with a focal point within the XR environment **128** of the eyes of the user **149** based on eye tracking.

[0267] In some implementations, a size parameter (e.g., radius) of the second graphical element is (**1120**) a function of a distance between the second portion of the content and one or more eyes of the user. In some implementations, the size of the second indicator element increases as the distance between the first portion of the content and the physical object decreases, and the size of the second indicator element decreases as the distance between the first portion of the content and the physical object increases.

[0268] In some implementations, as represented by block **1122**, the method **1100** includes: while displaying the content, detecting a subsequent input with the physical object associated with moving (e.g., translating and/or rotating) the content; and in response to detecting the subsequent input, moving the content based on the subsequent input. As one example, with reference to FIG. **8**D, the electronic device **120** translates the XR content **802** within the XR environment **128** in response to detecting the translational movement **832** of the proxy object **804** in FIG. **8**C. For example, the directionality and displacement of the translational movement of the XR content **802** within the XR environment **128** corresponds to the spatial parameters of the translational movement **832** of the proxy object **804** in FIG. **8**C (e.g., change in positional values, change in rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc.). One of ordinary skill in the art will appreciate that the XR content **802** may be similarly rotated.

[0269] As another example, with reference to FIG. **8**G, the electronic device **120** translates the XR content **802** within the XR environment **128** in response to detecting the translational movement **862** of the gaze direction **806** in FIG. **8**F. For example, the directionality and displacement of the translational movement of the XR content **802** within the XR environment **128** corresponds to the spatial parameters of the translational movement **862** of the gaze direction **806** in FIG. **8**F (e.g., change in positional values, change in rotational values, displacement, spatial acceleration, spatial velocity, angular acceleration, angular velocity, etc.).

[0270] In some implementations, detecting the subsequent input corresponds to (**1124**): obtaining an indication that an affordance on the physical object has been actuated; and detecting at least one of rotational or translational movement of the physical object. For example, detecting actuation of the affordance corresponds to a selection portion of the subsequent input.

[0271] In some implementations, detecting the subsequent input corresponds to (**1126**): obtaining an indication that an input value associated with how hard the physical object is being grasped by the user exceeds a threshold input value; and detecting at least one of rotational or translational movement of the physical object. For example, the input (pressure) value corresponds to a selection portion of the subsequent input. In some implementations the pressure threshold is non-deterministic (i.e., a predetermined pressure value) or deterministic based on one or more factors such as user preferences, usage history, current content, current context, etc.

[0272] In some implementations, a magnitude of the subsequent input is modified (**1128**) by an amplification factor to determine a magnitude of the movement of the content. In some implementations the amplification factor is non-deterministic (e.g., a predetermined value) or deterministic based on one or more factors such as user preferences, usage history, selected content, current context, etc.

[0273] While various aspects of implementations within the scope of the appended claims are described above, it should be apparent that the various features of implementations described above may be embodied in a wide variety of forms and that any specific structure and/or function described above is merely illustrative. Based on the present disclosure one skilled in the art should appreciate that an aspect described herein may be implemented independently of any other aspects and that two or more of these aspects may be combined in various ways. For example, an apparatus may be implemented and/or a method may be practiced using any number of the aspects set forth herein. In addition, such an apparatus may be implemented and/or such a method may be practiced using other structure and/or functionality in addition to or other than one or more of the aspects set forth herein.

[0274] It will also be understood that, although the terms "first", "second", etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first media item could be termed a second media item, and, similarly, a second media item could be termed a first media item, which changing the meaning of the description, so long as the occurrences of the "first media item" are renamed consistently and the occurrences of the "second media item" are renamed consistently. The first media item and the second media item are both media items, but they are not the same media item.

[0275] The terminology used herein is for the purpose of describing particular implementations only and is not intended to be limiting of the claims. As used in the description of the implementations and the appended claims, the singular forms "a", "an", and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will also be understood that the term "and/or" as used herein refers to and encompasses any and all possible combinations of one or more of the associated listed items. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0276] As used herein, the term "if" may be construed to mean "when" or "upon" or "in response to determining" or "in accordance with a determination" or "in response to detecting," that a stated condition precedent is true, depending on the context. Similarly, the phrase "if it is determined [that a stated condition precedent is true]" or "if [a stated condition precedent is true]" or "when [a stated condition precedent is true]" may be construed to mean "upon determining" or "in response to determining" or "in accordance with a determination" or "upon detecting" or "in response to detecting" that the stated condition precedent is true, depending on the context.

What is claimed is:

1. A method comprising:

at a computing system including non-transitory memory and one or more processors, wherein the computing system is communicatively coupled to a display device and one or more input devices:

displaying, via the display device, a first plurality of graphical elements associated with a first plurality of output modalities within an extended reality (XR) environment;

while displaying the first plurality of graphical elements, detecting first movement of a physical object; and

in response to detecting the first movement of the physical object:

in accordance with a determination that the first movement of the physical object causes the physical object to breach a distance threshold relative to a first graphical element among the first plurality of graphical elements, selecting a first output modality associated with the first graphical element as a current output modality for the physical object; and

in accordance with a determination that the first movement of the physical object causes the physical to breach the distance threshold relative to a second graphical element among the first plurality of graphical elements, selecting a second output modality associated with the second graphical element as the current output modality for the physical object.

2. The method of claim **1**, wherein the first and second output modalities cause different visual changes within the XR environment.

3. The method of claim **1**, further comprising:

in accordance with a determination that the first movement of the physical object causes the physical object to breach the distance threshold relative to the first graphical element among the first plurality of graphical elements:

maintaining display of the first graphical element adjacent to the physical object; and

ceasing display of a remainder of the first plurality of graphical elements that does not include the first graphical element; and

in accordance with the determination that the first movement of the physical object causes the physical object to breach the distance threshold relative to the second graphical element among the first plurality of graphical elements:

maintaining display of the second graphical element adjacent to the physical object; and

ceasing display of a remainder of the first plurality of graphical elements that does not include the second graphical element.

4. The method of claim **3**, further comprising:

after selecting the first output modality associated with the first graphical element as the current output modality for the physical object, detecting second movement of the physical object; and

in response to detecting second movement of the physical object, moving the first graphical element based on the second movement of the physical object in order to maintain display of the first graphical element adjacent to the physical object.

5. The method of claim **3**, further comprising:

after ceasing display of the remainder of the first plurality of graphical elements, obtaining an indication of a touch input directed to the physical object; and

in response to obtaining the indication of the touch input, redisplaying, via the display device the first plurality of graphical elements within the XR environment.

6. The method of claim **1**, further comprising:

prior to displaying the first plurality of graphical elements, obtaining an indication of a touch input directed to the physical object, and

wherein displaying the first plurality of graphical elements within the XR environment includes displaying the first plurality of graphical elements within the XR environment in response to obtaining the indication of the touch input.

7. The method of claim **1**, further comprising:

in accordance with a determination that the first movement of the physical object does not cause the physical object to breach the distance threshold relative to the first graphical element or the second graphical element:

maintaining an initial output modality as the current output modality for the physical object; and

maintaining display of the first plurality of graphical elements.

8. The method of claim **1**, further comprising:

after selecting the first output modality associated with the first graphical element as the current output modality for the physical object, detecting a subsequent marking input with the physical object; and in response to detecting the subsequent marking input, displaying, via the display device, one or more marks within the XR environment based on the subsequent marking input and the first output modality.

9. The method of claim **8**, further comprising:

in response to detecting the subsequent marking input:

in accordance with a determination that an input associated with how hard the physical object is being pressed against a physical surface corresponds to a first input value, displaying, via the display device, one or more marks with a first appearance within the XR environment based on the subsequent marking input and the first output modality, wherein the first appearance is associated with a parameter of the one or more marks that corresponds to the first input value; and

in accordance with a determination that the input associated with how hard the physical object is being pressed against a physical surface corresponds to a second input value, displaying, via the display device, one or more marks with a second appearance within the XR environment based on the subsequent marking input and the first output modality, wherein the second appearance is associated with the parameter of the one or more marks that corresponds to the second input value.

10. The method of claim **9**, wherein the parameter corresponds to one of a radius, width, thickness, intensity, translucency, opacity, color, or texture of the one or more marks within the XR environment.

11. The method of claim **8**, further comprising:

in response to detecting the subsequent marking input:

in accordance with a determination that an input associated with how hard the physical object is being grasped by the user corresponds to a first input value, displaying, via the display device, one or more marks with a first appearance within the XR environment based on the subsequent marking input and the first output modality, wherein the first appearance is associated with a parameter of the one or more marks that corresponds to the first input value; and

in accordance with a determination that the input associated with how hard the physical object is being grasped by the user corresponds to a second input value, displaying, via the display device, one or more marks with a second appearance within the XR environment based on the subsequent marking input and the first output modality, wherein the second appearance is associated with the parameter of the one or more marks that corresponds to the second input value.

12. The method of claim **11**, wherein the parameter corresponds to one of a radius, width, thickness, intensity, translucency, opacity, color, or texture of the one or more marks within the XR environment.

13. The method of claim **1**, further comprising:

prior to displaying the first plurality of graphical elements, obtaining a grip pose associated with a current manner in which the physical object is being held by a user, wherein the first plurality of graphical elements is a function of the grip pose; and

in response to obtaining the grip pose:

in accordance with a determination that the grip pose corresponds to a first grip pose, displaying, via the display device, the first plurality of graphical elements associated with the first plurality of output modalities within the XR environment; and

in accordance with a determination that the grip pose corresponds to a second grip pose different from the first grip pose, displaying, via the display device, a second plurality of graphical elements associated with a second plurality of output modalities within the XR environment.

14. The method of claim **13**, further comprising:

after displaying the first plurality of graphical elements associated with the first plurality of output modalities within the XR environment, detecting a change in the grip pose from the first grip pose to the second grip pose; and

in response to detecting the change in the grip pose, replacing display of the first plurality of graphical elements within the XR environment with the second plurality of graphical elements associated with the second plurality of output modalities within the XR environment.

15. The method of claim **1**, further comprising:

prior to displaying the first plurality of graphical elements, obtaining information indicating whether a first end or a second end of the physical object is facing outward; and

in response to obtaining the information indicating whether the first end or the second end of the physical object is facing outward:

in accordance with a determination that the first end of the physical object is facing outward, displaying, via the display device, the first plurality of graphical elements associated with the first plurality of output modalities within the XR environment; and

in accordance with a determination that the second end of the physical object is facing outward, displaying, via the display device, a second plurality of graphical elements associated with a second plurality of output modalities within the XR environment.

16. The method of claim **15**, further comprising:

after displaying the first plurality of graphical elements associated with the first plurality of output modalities within the XR environment, detecting a change from a first end of the physical object facing outward to a second end of the physical object facing outward; and

in response to detecting the change from the first end of the physical object facing outward to the second end of the physical object facing outward, displaying, via the display device, the second plurality of graphical elements associated with the second plurality of output modalities within the XR environment.

17. A device comprising:

one or more processors;

a non-transitory memory;

an interface for communicating with a display device and one or more input devices; and

one or more programs stored in the non-transitory memory, which, when executed by the one or more processors, cause the device to:

display, via the display device, a first plurality of graphical elements associated with a first plurality of output modalities within an extended reality (XR) environment;

while displaying the first plurality of graphical elements, detect first movement of a physical object; and

in response to detecting the first movement of the physical object:

in accordance with a determination that the first movement of the physical object causes the physical object to breach a distance threshold relative to a first graphical element among the first plurality of graphical elements, select a first output modality associated with the first graphical element as a current output modality for the physical object; and

in accordance with a determination that the first movement of the physical object causes the physical to breach the distance threshold relative to a second graphical element among the first plurality of graphical elements, select a second output modality associated with the second graphical element as the current output modality for the physical object.

18. The device of claim **17**, wherein the one or more programs further cause the device to:

in accordance with a determination that the first movement of the physical object causes the physical object to breach the distance threshold relative to the first graphical element among the first plurality of graphical elements:

maintain display of the first graphical element adjacent to the physical object; and

cease display of a remainder of the first plurality of graphical elements that does not include the first graphical element; and

in accordance with the determination that the first movement of the physical object causes the physical object to breach the distance threshold relative to the second graphical element among the first plurality of graphical elements:

maintain display of the second graphical element adjacent to the physical object; and

cease display of a remainder of the first plurality of graphical elements that does not include the second graphical element.

19. The device of claim **17**, wherein the one or more programs further cause the device to:

in accordance with a determination that the first movement of the physical object does not cause the physical object to breach the distance threshold relative to the first graphical element or the second graphical element:

maintain an initial output modality as the current output modality for the physical object; and

maintain display of the first plurality of graphical elements.

20. A non-transitory memory storing one or more programs, which, when executed by one or more processors of a device with an interface for communicating with a display device and one or more input devices, cause the device to:

display, via the display device, a first plurality of graphical elements associated with a first plurality of output modalities within an extended reality (XR) environment;

while displaying the first plurality of graphical elements, detect first movement of a physical object; and

in response to detecting the first movement of the physical object:

in accordance with a determination that the first movement of the physical object causes the physical object to breach a distance threshold relative to a first graphical element among the first plurality of graphical elements, select a first output modality associated with the first graphical element as a current output modality for the physical object; and

in accordance with a determination that the first movement of the physical object causes the physical to breach the distance threshold relative to a second graphical element among the first plurality of graphical elements, select a second output modality associated with the second graphical element as the current output modality for the physical object.

21. The non-transitory memory of claim **20**, wherein the one or more programs further cause the device to:

in accordance with a determination that the first movement of the physical object causes the physical object to breach the distance threshold relative to the first graphical element among the first plurality of graphical elements:

maintain display of the first graphical element adjacent to the physical object; and

cease display of a remainder of the first plurality of graphical elements that does not include the first graphical element; and

in accordance with the determination that the first movement of the physical object causes the physical object to breach the distance threshold relative to the second graphical element among the first plurality of graphical elements:

maintain display of the second graphical element adjacent to the physical object; and

cease display of a remainder of the first plurality of graphical elements that does not include the second graphical element.

22. The non-transitory memory of claim **20**, wherein the one or more programs further cause the device to:

in accordance with a determination that the first movement of the physical object does not cause the physical object to breach the distance threshold relative to the first graphical element or the second graphical element:

maintain an initial output modality as the current output modality for the physical object; and

maintain display of the first plurality of graphical elements.

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